2013 CALIFORNIA DESERT VEGETATION MAP AND ACCURACY ASSESSMENT IN SUPPORT OF THE DESERT RENEWABLE ENERGY CONSERVATION PLAN

Vegetation Classification and Mapping Program

California Department of Fish and Wildlife and

Aerial Information Systems, Inc.

For the

California Department of Fish and Wildlife Renewable Energy Program and the

California Energy Commission

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FINAL

ABSTRACT

Aerial Information Systems (AIS) and the California Department of Fish and Wildlife (CDFW) Vegetation Classification and Mapping Program (VegCAMP) created a vegetation map of a 5,969,650-acre portion of the Mojave Desert and Colorado Desert in California to assist with the development of the Desert Renewable Energy Conservation Plan (DRECP). The map was produced using heads up digitizing based on 2010 National Agricultural Imagery Program (NAIP) imagery. The minimum mapping unit (MMU) was 10 acres, with exceptions made for wetlands and certain wash types (1 acre MMU) and areas characterized as human land use polygons (2.5 acre MMU). This map will provide planners with detailed information to help identify high quality habitats and rare communities. Although the primary purpose of the map is to document vegetation communities, it provides multiple attributes including structural data such as herbaceous, shrub and tree cover, and information about the level of disturbance within the vegetation stand. These are important habitat factors for Covered Species of the DRECP, including the Mohave ground squirrel and desert tortoise.

This report covers the project purpose, intended map uses, and accuracy assessment of the map as conducted by VegCAMP and the California Native Plant Society. A separate report by AIS (Menke *et al.* 2013) discusses the ecological setting in the mapping area and provides a thorough discussion of mapping standards and methods. Their report also includes descriptions, photointerpretation signatures, distributions, elevation ranges, and ground photos of the vegetation types mapped.

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INTRODUCTION

Aerial Information Systems (AIS) and the California Department of Fish and Wildlife (CDFW) Vegetation Classification and Mapping Program (VegCAMP) created a vegetation map of a portion of the Mojave Desert and Colorado Desert in California to provide landscape level information for the conservation and land use planning associated with the Desert Renewable Energy Conservation Plan (DRECP)[1] (Figure 1). Details of the project area, descriptions of the ecological setting, the mapping methods and standards, and descriptions of the map classes are provided in a separate report by AIS (Menke *et al*. 2013). In this report, the project background, uses of the map, the results of the accuracy assessment, and the portions of the project specific to VegCAMP's role are discussed.

Figure 1*: DRECP project area and mapping boundary.*

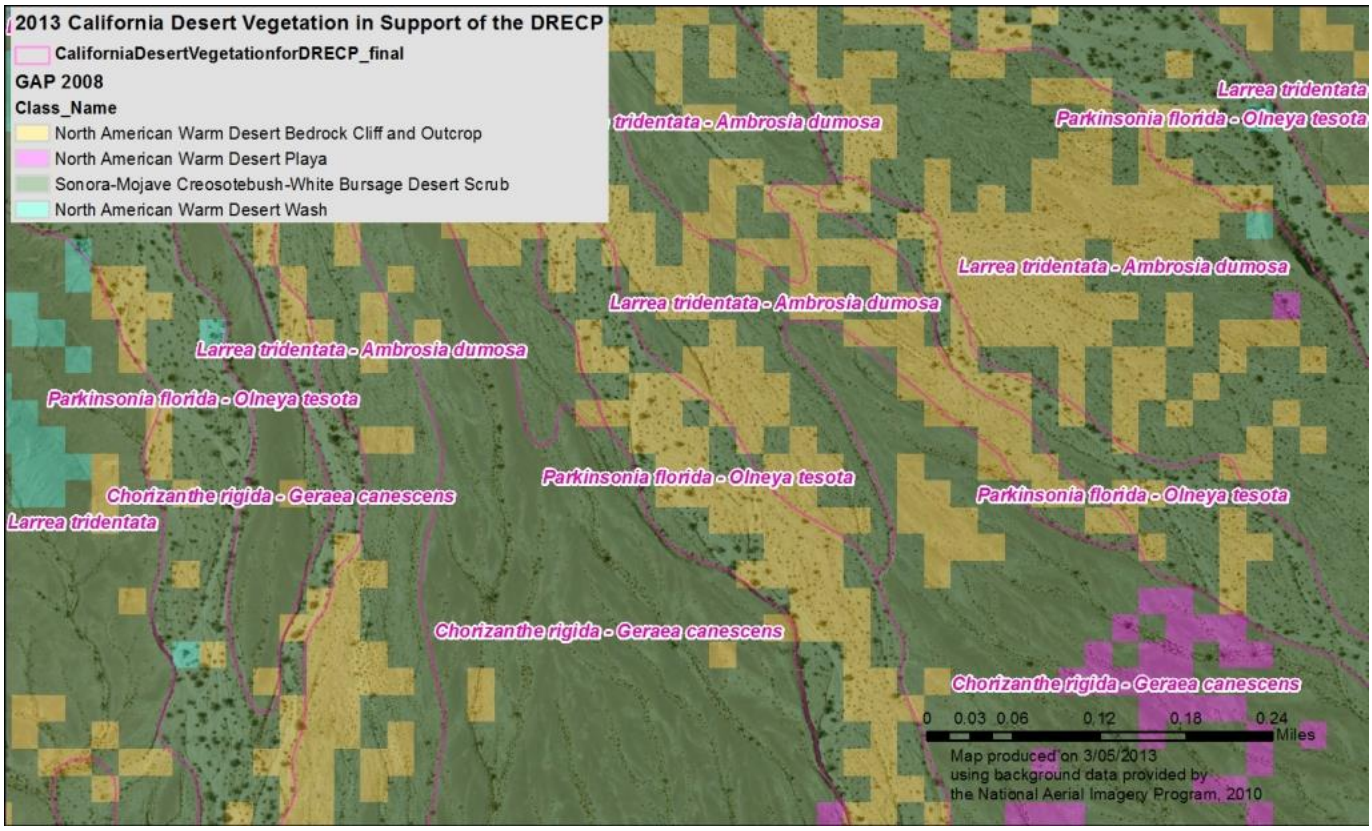
The Vegetation Map data are expected to inform decisions under the DRECP on the selection or avoidance of areas of certain vegetation type and quality which could not be evaluated with previously existing data. For example, with only positive-siting data sets, such as California Natural Diversity Database (CNDDB) records of listed species or covered natural communities, large portions of the Western Mojave lacked sufficient species or natural community

[1] http://www.drecp.org/

data to evaluate the significance or relative conservation value of particular areas. Existing coarse information was shown in test cases to be spatially inadequate or too dated to provide reasonable estimates of habitat type or quality for conservation and connectivity analysis.

A further problem with previously existing data is the scale and accuracy of the vegetation maps. The most recent state-wide mapping effort, California GAP 2008,[2] shows a minimum pixel size of 30-meter blocks and the map accuracy is largely untested. In the DRECP Vegetation Map, by contrast, the level of spatial detail is much finer and the vegetation polygons conform to the visually distinct structural and floristic breaks visible on the commonly accessible recent fine-scale National Agriculture Imagery Project (NAIP) imagery (Figure 2). As discussed below, a rigorous accuracy assessment was conducted on the DRECP Map.

Figure 2*: Detail of GAP 2008 and the current map.*
The current map is displayed in pink-outlined polygons and labels over the GAP map, with NAIP 2010 imagery as base. Note the GAP map's depiction of playa where it is not present and the confusion of important fine-scale vegetation units such as Parkinsonia florida–Olneya tesota Wash Woodland due to the coarseness of pixel-based attribution. The current map's polygons correspond closely to stand boundaries as depicted in the imagery.



[2] http://gap.uidaho.edu/index.php/california-land-cover/

Although the scale of the DRECP Vegetation Map is finer than any other currently available for any other large portion of the DRECP, there are limits to the depiction of features on the ground. The limits of these mappable features are important to understand when determining proper uses of the map. For example, fine-scale washes dissect the old alluvial fans and pediments of much of the desert. Although the vegetation may be distinctly different than the surrounding uplands, even in very narrow washes, these are not depicted due to the time and delineation constraints inherent in a project as expansive as this (Figure 3).

Figure 3*: Narrow dendritic washes depicted in the current map.*
Note the truncation of individual yellow shaded polygons (mapped at the Macrogroup level in this view) as the washes narrow uphill into the gray- and brown-shaded upland vegetation polygons. The minimum width allowed for this project is approximately 30 m (100 ft). Any wash regularly narrower than that was included in the surrounding upland vegetation polygon.

The DRECP Vegetation Map described herein uses the National Vegetation Classification System (NVCS)[3] as the map classification. The version of the NVCS hierarchy used for the map is consistent with the Second Edition of *A Manual of California Vegetation* (MCVII) (Sawyer *et al*. 2009). The NVCS hierarchy is currently being updated and, when complete, may be crosswalked to the existing DRECP map. Additionally, each polygon is cross-walked to other useful classification schemes including the Ecological Systems used in the GAP 2008 map, the California Wildlife Habitat

[3] http://usnvc.org/data-standard/

Relationships,[4] and CALVEG[5] classification systems. This enables a broader relational understanding amongst users familiar with those classification systems. The map is also translated to the general Natural Community system that is the basic framework used for DRECP planning.

The NVCS uses a hierarchy of levels ranging from general to specific with regard to ecosystem and floristics.[6] Each level is described and defined in standard terminology and is useful for different purposes. This map uses the second most specific level, Alliance,[7] as its finest thematic resolution. An NVCS Alliance-level classification of the vegetation in the DRECP map area was previously established from sampling and analysis efforts (detailed below).

By keeping the classification at the Alliance level, we were able to map to a standard classification that is well-supported by data without the extensive data collection required for a classification at the most specific level, the Association. Given the millions of acres in the mapping area and the relatively short timeline necessitated by the DRECP environmental review schedule, several decisions were made to improve efficiency of production and evaluation of the map:

- The map classification is at the Alliance level, unlike some finer scale maps which are at the Association level. Vegetation is mapped to the less-detailed Group or Macrogroup levels when it was not possible to discern the type at the Alliance level.
- Although much reconnaissance and accuracy assessment data were collected, little new classification sampling data were collected for classification refinement. This shortened the time from beginning to end of the project by at least one field season (6-8 months).
- For this project, data collection was primarily used to test map accuracy.

Despite the Alliance-level thematic information, a relatively high level of detail is afforded by reporting structural attributes, such as the percentage of vegetation cover and the presence of various types of disturbance. This information enables more detailed evaluation of site-specific features, such as site quality or habitat characteristics, and aids in overall regional evaluation for conservation significance. The full suite of attributes for the new mapping effort was determined by discussing the proposed uses of the map with members of the interagency Renewable Energy Action Team (REAT, comprised of biologists and managers from CDFW, the California Energy Commission, the

[4] http://www.dfg.ca.gov/biogeodata/cwhr/

[5] http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192

[6] The NVCS levels from general to specific are: Class, Subclass, Formation, Division, Macrogroup, Group, Alliance, and Association.

[7] An Alliance is typically defined by one or two diagnostic species of high cover usually in the highest vegetation stratum at the site. For example, the California juniper Alliance is dominated by *Juniperus californica* in the tree layer.

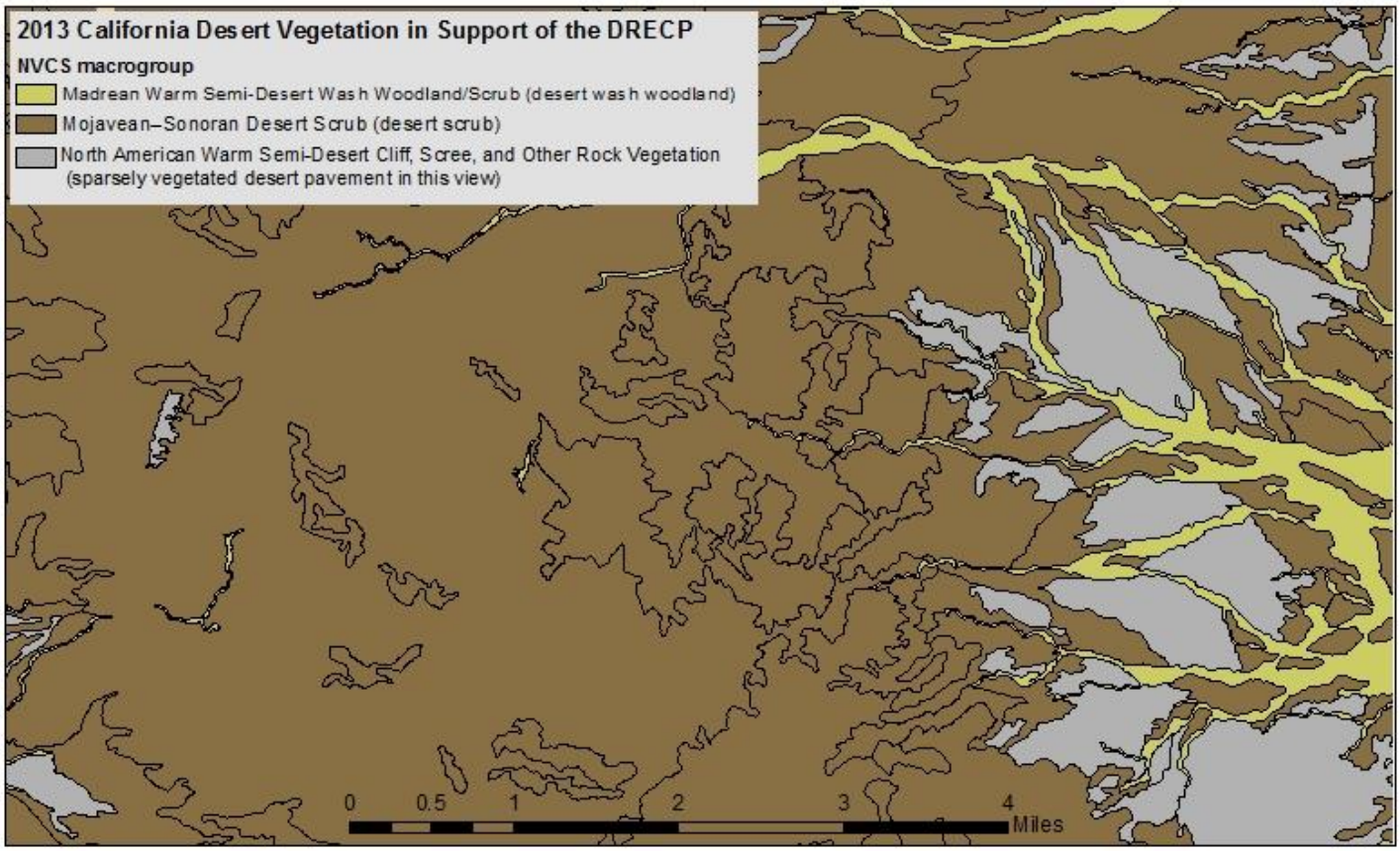
Bureau of Land Management, and the U.S. Fish and Wildlife Service) and by interviewing other biologists and land managers. The attributes of the map are described in detail in Menke *et al.* (2013).

The final data set and metadata from the DRECP Vegetation Map forms a central component of an integrated land cover map (and data set) that covers the entire 22,586,444-acre DRECP planning area. The classifications used in the DRECP land cover map, environmental review and conservation planning, differ from those used in the DRECP vegetation map and can be viewed on CDFW BIOS website. The DRECP land cover map and dataset integrate the DRECP vegetation map with the best available mapping data for the entire planning area, including that from California GAP 2008, CDFW vegetation mapping in Anza-Borrego (Keeler-Wolf *et al.* 1998) and the Mojave Desert Ecosystem Program (Thomas *et al.* 2004), and updates for agricultural and urban areas from the California Department of Conservation Farmland Mapping and Monitoring Program.

The main thematic component for each individual mapped polygon in the DRECP vegetation map is based upon the most detailed level of the classification that can reliably be mapped with the resolution, supporting data, and expertise of the photo interpreters involved. In general, the Alliance level is the base unit of classification. However, for some vegetation, such as herbaceous or sparsely-vegetated types, it was not possible to refine the resolution as finely as the Alliance and so a more general level such as Group, or in some cases Macrogroup, was the finest reliably depicted level.

No polygon can be mapped to a finer level than is supported by the imagery or data, but all types can be hierarchically linked to coarser levels of classification. For example, a depiction of general vegetation across the entire mapping area might be more easily interpreted if a map of Macrogroups were displayed rather than a map showing all of the Alliances (Figure 4). Generalization to the Macrogroup level may even be useful to help describe certain features of the desert that correspond to habitat for species that are not known to cue into finer floristic or structural levels of the vegetation, and therefore, to the finer levels of the classification. Thus, the flexibility of the classification is an advantage and can be used to display the most appropriate level of the classification for a particular purpose.

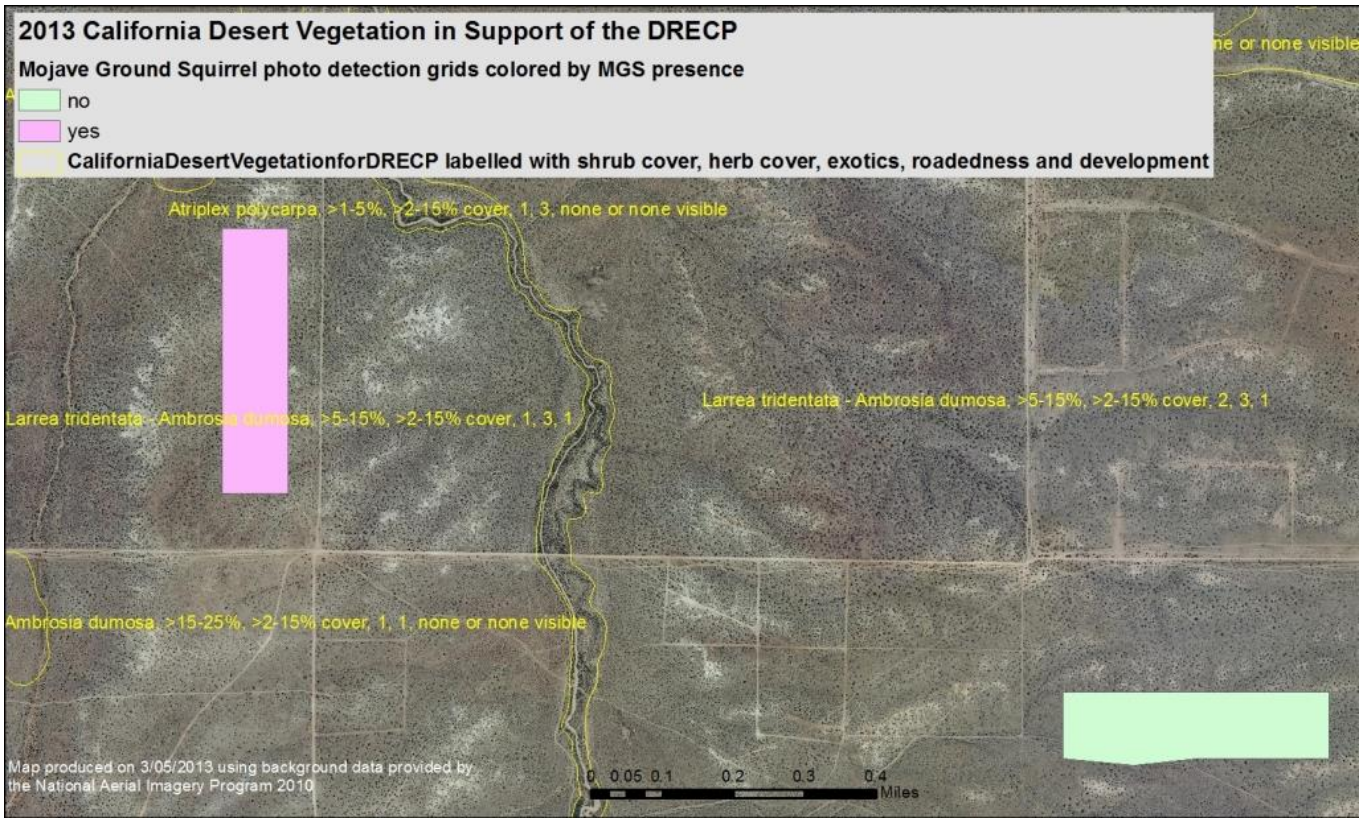
Figure 4*: Macrogroup-level map of an area near Blythe in the Colorado Desert.*
Polygons are colored by Macrogroup, which simplifies this scene into just 3 main natural types generally translated to: desert wash woodland, desert scrub, and sparsely vegetated desert pavement. Individual polygon boundaries within larger unicolored swaths of vegetation may be finer-level units of classification (e.g., Alliances) within the same Macrogroup or may also represent cover class differences.



In addition to the vegetation type, each vegetated map polygon has a set of cover values that estimate the cover of the main structural layers. Cover of trees, shrubs, and herbaceous strata are estimated separately if present, and isolated trees, even at less than 1 % cover, are noted. Such structural data are very important when aggregated or analyzed in various ways. For example, a raptor that requires isolated Joshua trees for perching or nesting may use a stand that technically would be called Creosote bush-White bursage Alliance although it contains occasional Joshua trees. These trees are easily seen and identified as a separate category augmenting the main thematic call of Creosote bush-White bursage Alliance by using the Joshua tree presence attribute. Thus, although technically not a Joshua tree woodland, the additional habitat value will be noted for the polygon. Similarly, isolated hardwoods (e.g., oaks or riparian trees) and conifers such as pinyon pines or junipers are noted even when they have less than 1% cover. The microphyllous hardwoods *Olneya tesota* and *Parkinsonia florida* are noted if they are present throughout the stand, even in trace amounts.

Attribute information can be sorted and selected to depict important habitat or site quality information at a fine spatial resolution. This can assist in local-scale assessment of various aspects of relative significance/value in land quality and type. In the example presented in Figure 5, potential habitat value changes due to floristic composition or structure can be compared to Mohave ground squirrel local or regional abundance as quantified by camera trapping success rates (P. Leitner, pers. comm. 2012).

Figure 5*: Depiction of selected attributes within individual vegetation polygons.*
This map shows a portion of the western Mojave Desert in which sampling for the presence of Mohave ground squirrel took place in spring 2011; NAIP 2010 imagery is used as a map base. Rectangles are sample grids for squirrels, yellow polygons and labels show attribute strings in the following order: Vegetation type, shrub cover, herbaceous cover, and codes for exotic plant cover, road density, and development (codes of low to high numbers reflect increasing intensity of impact). Note that the lower cover of exotics is a potentially meaningful attribute determining Mohave ground squirrel habitat.



Regional composition of vegetation and selected vegetation attribute correlations to habitat quality can be assessed using the inherent flexibility of the mapping attributes. Mirroring NatureServe Heritage Methodology,[8] vegetation (called natural communities by NatureServe) is assessed by a combination of regional and global ranking based upon extent, number, and quality of occurrences. Accurate fine-scale mapping of floristically defined vegetation with

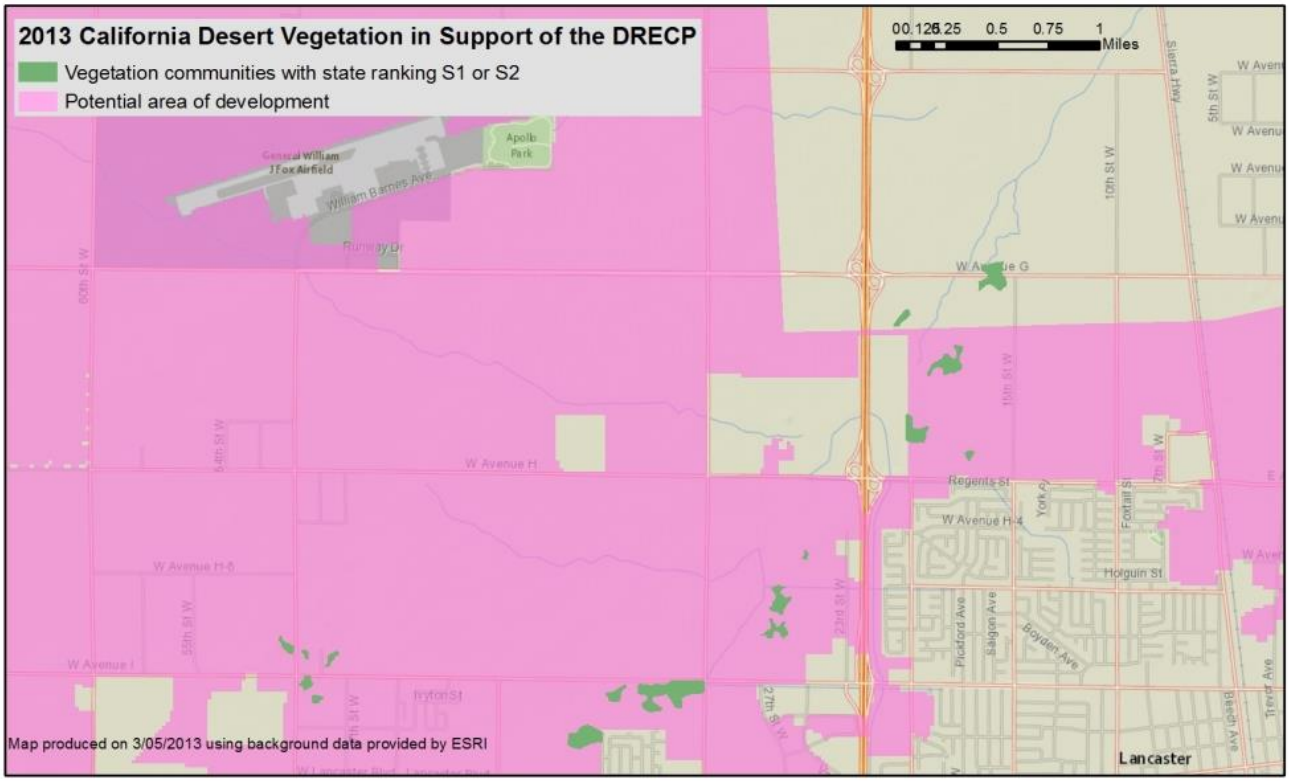
[8] http://www.natureserve.org/publications/ConsStatusAssess_RankMethodology.jsp

attributes denoting quality can produce reliable results for assessing the rarity and threat ranks used to evaluate the conservation significance of these "natural communities" in a conservation planning process such as the DRECP.

The underpinnings of the planning decisions in the DRECP, formally considered a Natural Community Conservation Plan pursuant to the Natural Communities Conservation Planning Act (§2800-2835 of the California Fish and Game Code), are driven by identification and evaluation of rarity and threat of these natural communities and their relationships to habitat of covered species. Rarity of natural communities in the DRECP is being considered to ensure appropriate representation, long-term viability, and conservation in the context of impacts expected from construction of renewable energy facilities over the next 30 years. A code for state and local rarity was applied to each of the floristically defined and mapped vegetation types. Along with this code, additional analyses were made based on a combination of attributes such as size of polygon and thresholds of site quality (based on clearing, development, roadedness, and invasive exotic plant species cover). Identifying the locations of existing examples of these communities in relationship to proposed development areas enables quantitative and defensible decisions to be made throughout the plan area (Figure 6).

Figure 6*: An example of local and regionally rare vegetation communities.*

"Community elements," as they are called in DRECP, are depicted near Lancaster in the western Mojave Desert. Rarity ranking, standardized by Natural Heritage methodology, is color-coded for rare natural communities in this area. In this case, Forestiera pubescens (state rank S2) is shown in green against a backdrop of possible Development Focus Areas (or DFAs, shown in pink) in this portion of the DRECP. Using a set of criteria based on the rarity of such types, a certain number acres and occurrences can be identified to conserve this and other rare natural communities. Note: this depiction of a DFA should be considered a hypothetical example.



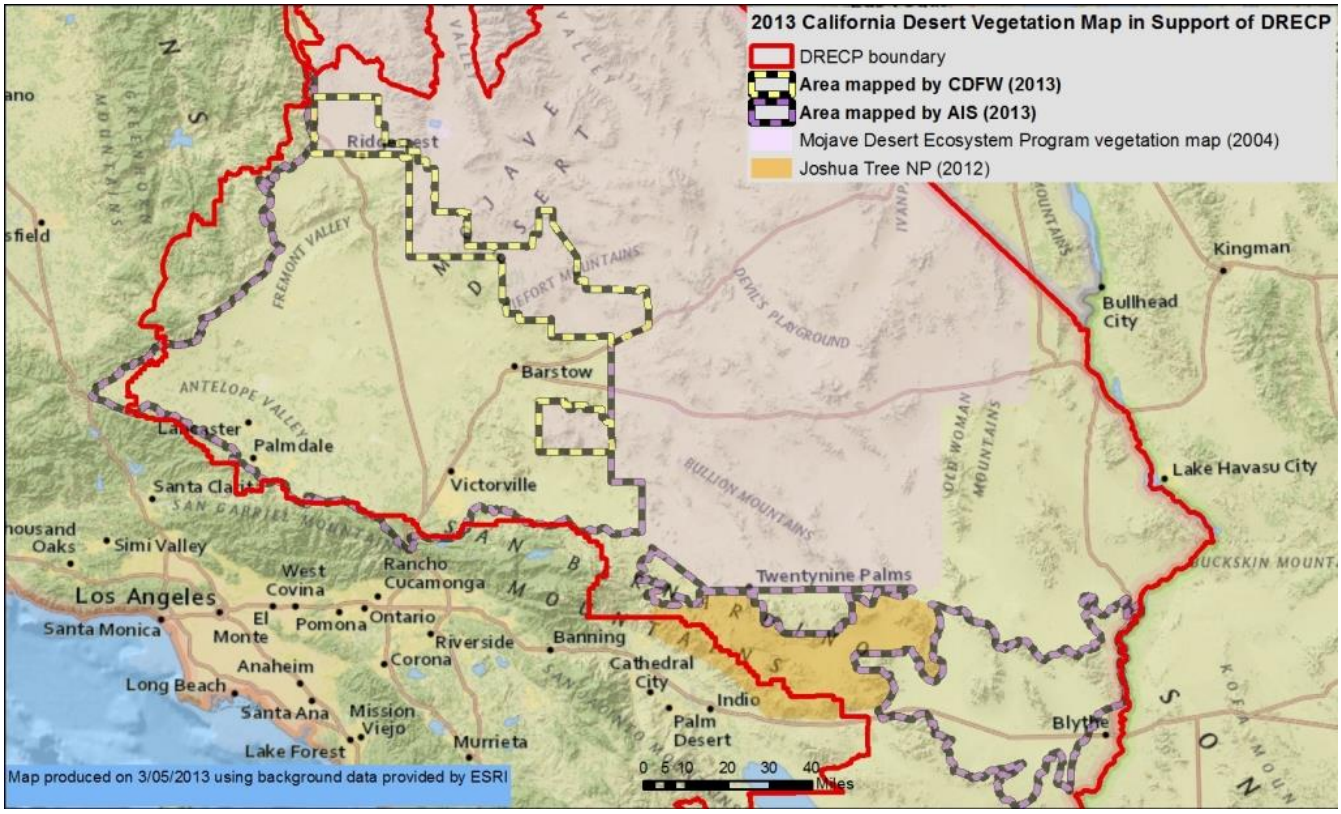
This multi-attribute, fine-scale map is the product of a synthesis of information that is intended to optimize its use. The intention is to capitalize on the rigor and defensibility of the vegetation classification system already developed for the California Desert over years of data collection and analysis while adding useful attributes that can help quantify a number of landscape quality, contextual, and habitat relationships. This unique combination of vegetation classification and environmental attribution will be invaluable for informing the regional planning component of the DRECP and future regional planning projects.

METHODS

MAPPING AREA

The mapping area covers a total of 5,969,650 acres; AIS mapped 5,190,318 and VegCAMP mapped 779,332 acres (Figure 7). The selection of the areas mapped in this effort was driven by the need for detailed vegetation mapping within those parts of the DRECP having the highest likelihood of renewable energy development. The portion mapped by AIS is bounded by the borders of a vegetation map completed in 2004 for the Mojave Desert Ecosystem Program (MDEP) and in 2012 for Joshua Tree National Park. The boundary of VegCAMP's study area was chosen to eliminate an arbitrary gap based on the original MDEP boundary around Ord Mountain, to absorb an additional core area for the Mohave ground squirrel, and to include more critical habitat area for the desert tortoise. In some places it was determined by the availability of high resolution 1-ft. ancillary imagery via ImageConnect© at the time mapping started.

Figure 7*: Areas mapped by AIS and VegCAMP in 2013, and previous mapping efforts within the DRECP boundary.*

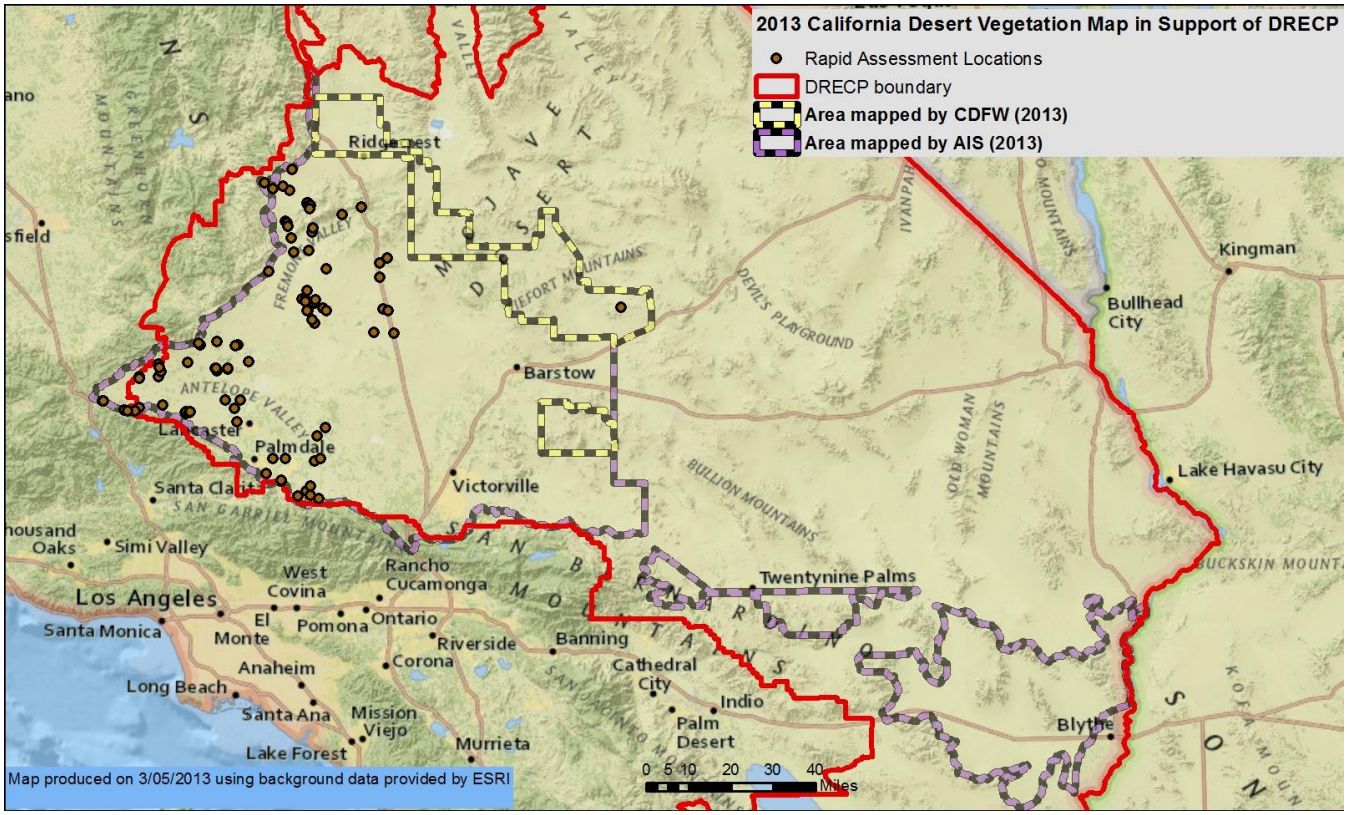


CLASSIFICATION

The map classification is based largely on work done in the area for previous and ongoing projects: Vegetation Mapping of Anza-Borrego Desert State Park and Environs (Keeler-Wolf *et al.* 1998), the Mojave Desert Ecosystem

Program's Vegetation Database (Thomas *et al.* 2004), Vegetation of Joshua Tree National Park (unpublished draft), and Vegetation Classification and Mapping at Lake Mead National Recreation Area, Mojave National Preserve and Death Valley National Park (in progress). VegCAMP collected an additional 98 Rapid Assessment vegetation field surveys in 2011 (Figure 8) using the field form and protocol in Appendix A. Additional mapping classes are based on those 98 unclassified surveys; some of these are considered provisional until better understood (for example, the *Ericameria cooperi* Provisional Alliance). Types from all of these sources were compiled and placed within the NVCS hierarchy as interpreted by VegCAMP in March of 2011. See Appendices B and C for the classification hierarchy and field key to vegetation types, respectively.

Figure 8*: Locations of Rapid Assessment surveys collected by VegCAMP in 2011.*



Plant nomenclature follows the Natural Resources Conservation Service PLANTS Database[9] or the first edition of The Jepson Manual (Hickman 1993) for taxa not included in PLANTS. See Appendix D for a crosswalk to names in The Jepson Manual, Second Edition (Baldwin *et al*. 2012), which was published after this project began.

[9] http://plants.usda.gov/java/

RECONNAISSANCE

Between February 2011 and March 2012, AIS and VegCAMP staff conducted field trips throughout the mapping area with 1-2 crews per trip to perform reconnaissance of vegetation types. This reconnaissance allowed better matching of the vegetation with the signatures seen on the imagery. Dr. Todd Keeler-Wolf of VegCAMP accompanied AIS on all but one of their trips and thus assured better calibration among reconnaissance teams. Additionally, California Native Plant Society (CNPS) staff attended two of the reconnaissance trips to better understand the classification in the area for which they were contracted to conduct an accuracy assessment of the map (discussed below). During reconnaissance, crews traversed the study areas in vehicles, stopping to assess the vegetation types at various points. GPS points were taken and observations were recorded for vegetation type and cover at that point. Observations were also made for vegetation seen at a distance, with the point of observation determined using a compass and laser rangefinder. Points were frequently taken to mark the transition from one vegetation type to another, to help the photointerpreter determine the location of the edges of stands. Sometimes one observation contained information about two or more stands, and other times the same stand was assessed in multiple places. Approximately 6600 reconnaissance observations were made. See Menke *et al.* (2013) for details on AIS's reconnaissance trips and a map of the locations of all reconnaissance points. Table 1 displays the dates and locations of VegCAMP's reconnaissance trips. The form used by VegCAMP staff during reconnaissance surveys can be found in Appendix E.

Table 1*: Trip dates and USGS quadrangles covered in VegCAMP's field reconnaissance.*

Dates	USGS 7 1/2' Quadrangles (generally listed west to east and north to south)
May 2 - 6, 2011	Cuddeback Lake, Blackwater Well, Black Hills, Superior Lake, Williams Well, Mud Hills, Lane Mountain, Paradise Range, Coyote Lake, Alvord Mountain West, Alvord Mountain East, Daggett, Minneola, Ord Mountain, Camp Rock Mine, Fry Mountains
May 23 -27, 2011	Pearsonville, White Hills, Inyokern, Ridgecrest North, Burro Canyon, Lone Butte, Spangler Hills East, West of Black Hills, Black Hills, Pilot Knob, Slocum Mountain, Blackwater Well, Superior Lake, Mud Hills, Coyote Lake, Alvord Mountain West, Alvord Mountain East, Ord Mountain, Camp Rock Mine, Grand View Mine, White Horse Mountain
Jun 2 -10, 2011	White Hills, Inyokern, Ridgecrest North, Burro Canyon, Lone Butte, Spangler Hills East, West of Black Hills, Cuddeback Lake, Slocum Mountain, Superior Valley, Goldstone, Lane Mountain, Coyote Lake, Alvord Mountain West, Alvord Mountain East, Dunn
Oct 10 -14, 2011	Pearsonville, White Hills, Inyokern, Ridgecrest North, Lone Butte, Superior Valley, Goldstone, East of Goldstone, Superior Lake, Mud Hills, Lane Mountain, Paradise Range, Coyote Lake, Alvord Mountain West
Nov 23 - 26, 2011	Spangler Hills East, Christmas Canyon, West of Nelson Lake, East of Goldstone, Williams Well, Paradise Range, Langford Well, East of Langford Well, Bitter Spring

MAPPING

The mapping area was broken into Modules and mapping of the project area was phased according to initial DRECP planning priorities (Figure 9). The Module including the far western Mojave Desert was delineated and attributed first, followed by a general eastward progression over time (Table 2).

Figure 9*: Map production Modules.*

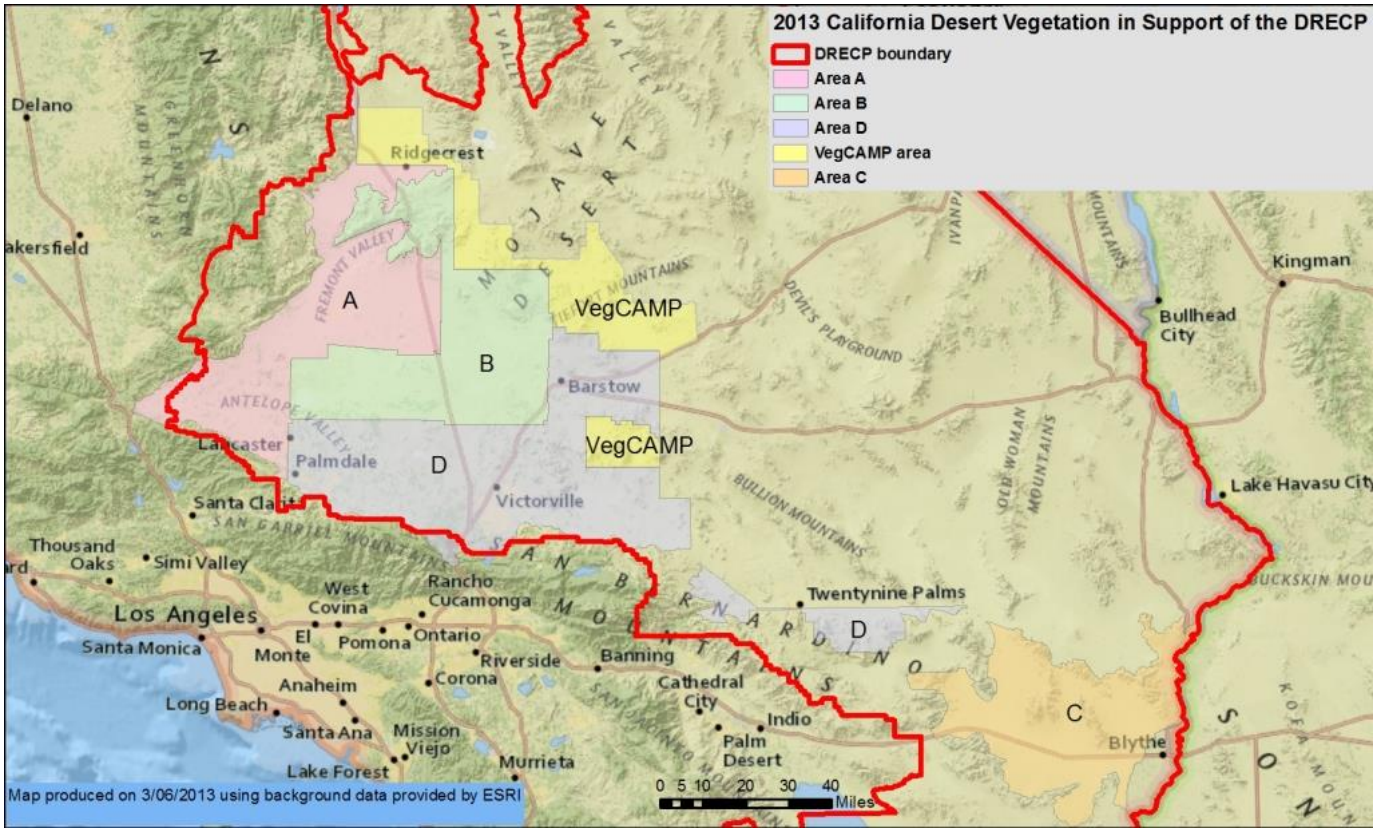


Table 2*: Completion dates for map Modules.*

Module	Completion Date of Map Module
A	Nov 2011
B	Mar 2012
D	May 2012
VegCAMP	Jun 2012
C	Sep 2012

AIS and VegCAMP used the same mapping rules, classification, and imagery sources, which are described in detail in Menke *et al.* (2013).

ACCURACY ASSESSMENT

VegCAMP and CNPS staff conducted an accuracy assessment (AA) to validate that the vegetation map achieved an overall accuracy of 80%, as required by Federal Geographic Data Committee standards (FGDC 2008) and the National Park Service.[10] Accuracy was assessed for each Module as it was completed to test the goodness of fit of the mapped type to the independently field assessed type. VegCAMP conducted the AA on all portions of the map except Module C, which was assessed by CNPS.

Polygons to sample for AA were allocated by VegCAMP or CNPS for each map module as it was received. The allocations were designed to ensure that most, if not all, of the mapped vegetation types were assessed, and the allocated polygons were chosen based on their accessibility by road. Polygons were selected in excess of the count targeted for each module and were assigned a priority level based on whether they were rare, core, or back-up polygons – with rare types having highest priority. Paper and digital field maps made use of the priority levels to guide field staff priorities for time spent reaching particular polygons.

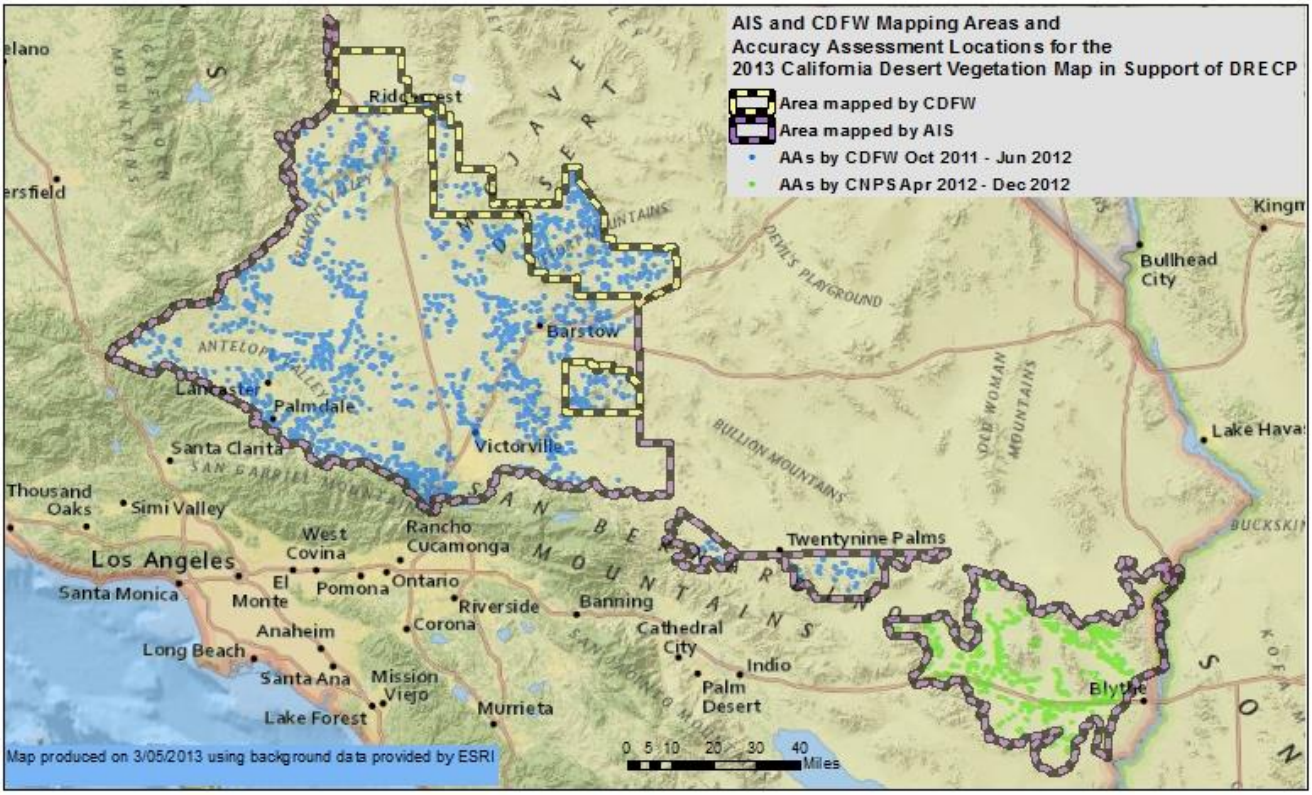
To prevent bias, 1) the field maps did not include the vegetation type or other attributes as assigned by AIS or VegCAMP and 2) no VegCAMP staff member collected field data (or scored accuracy in the office as described below) in areas she had mapped. AA data on private property were collected from public roads. Some of the stands were assessed from a distance using binoculars, a compass, laser rangefinder, and occasionally a spotting scope. ESRI's ArcPad software, loaded on Trimble's Juno SB devices, was used to collect GPS locations, and ArcPad's offset function was used to assist with distance surveys. See Appendix F for the form and protocol used for collecting accuracy assessment data.

From October 2011 through December 2012, the accuracy of mapped polygons was assessed at 3,078 point locations in the field throughout the mapping area; these are herein referred to as AAPs (Figure 10). The AAPs were stand-based, that is, both the type and the extent of the polygon were evaluated when possible. When a mapped polygon could be divided due to the presence of multiple types within the given MMU standards, an assessment was done for each type. All of the cover values and disturbance attributes except roadedness[11] were assessed when possible.

[10] http://science.nature.nps.gov/im/inventory/veg/index.cfm

[11] Roadedness was found to be difficult to assess objectively from the ground.

Figure 10*: Location of AA points (AAPs) surveyed by VegCAMP and CNPS.*



In the office, data from the field AAP forms were entered into an Access database that allowed the vegetation type recorded by the photointerpreter (PI) to be scored using the field surveys. Cover and disturbance attributes were not scored, but were provided as feedback to the PIs. If the field crews could not identify the vegetation type based on the field key, senior VegCAMP or CNPS staff assigned the correct type, when possible, based on the species covers recorded, any additional notes taken by the field crews, and field photos. All field calls were reviewed and a "Final call" was recorded in the database when possible.

A fuzzy logic method was used to score each AAP, rather than simply denoting whether 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 3), with a total of 5 possible points for each. Scores were summed for each vegetation type, then divided by the total possible score and multiplied by 100 for a percent accuracy. The scores were provided back to AIS or the VegCAMP mapper after each Module was completed so that specific and systematic errors could be corrected. This modular approach increased the final accuracy of the map product beyond the scores reported here.

Table 3*: Scoring rules and points.*

Code	Reason For Score	Score
A	PI completely correct.	5
B	The PI chose the correct Group OR the next level up in the hierarchy.	4
C	Threshold/transition between PI call and Final call. This was used when cover values of the dominant or indicator species were close to the values that would key to the PI's type (e.g., an AAP call of *Yucca brevifolia* Alliance for a stand with 1% evenly distributed *Yucca brevifolia* over *Larrea tridentata-Ambrosia dumosa* would get this score if the PI call was *Larrea tridentata-Ambrosia dumosa* Alliance with <1% *Yucca brevifolia*).	4
D	Correct Macrogroup OR next level up in hierarchy.	3
E	Based on close ecological similarity. Ecological similarity addresses assessed and mapped calls that contained vegetation with overlapping diagnostic species but were not technically closely related in the NVCS hierarchy. This was common in stands that contain a mix of species of late and early seral vegetation types and also common in zones of overlap between ecoregions.	3
F	Correct Division.	2
G	Some floristic/hydrologic similarity. This addresses cases in which the mapped and the assessed vegetation type had different diagnostic species, but bore some similarity in ecological traits based on predicted and actual setting such as hydrologic regime, overall climate, or successional state.	2
H	Correct only at Lifeform.	1
I	No similarity above Formation and incorrect life form.	0
J	Survey removed because there was a significant change in the polygon (e.g., the stand was burned, developed, or cleared since the date of the base imagery).	no score
K	Survey removed because inadequate portion (<10%) of the polygon was viewed by the field crew.	no score
L	Survey removed because field/PI data are incomplete, inadequate or confusing (e.g., cover values were not provided for key species in the stand).	no score
M	Supplementary record not scored (for multiple point assessments within a polygon where the AA call was the same).	no score

ACCURACY ASSESSMENT RESULTS

The map used 137 of the mapping units available in the hierarchical classification (Appendix B), and these were targeted for accuracy assessment. Land cover types (agriculture, urban, canals, etc.) were not targeted, as the focus was on vegetation. Accuracy assessment of some types was not possible within the time constraints of this project due to a lack of readily or legally accessible polygons.

Of the 3,078 AAPs collected within the mapped area, 175 were removed during analysis for one of the reasons (J through M) given in Table 2, and 57 surveys collected in the Ord Mountain region were removed from the analysis.[12] The final 2,846 AAPs addressed 102 of the 137 mapped vegetation types in the project area. The AAPs were spread over the Modules as shown in Table 4.

Table 4*: Number of final AAPs analyzed for each module.*

Area	# AAP's
A	438
B	323
C	832
D	904
VegCAMP	349
Full Map	**2846**

Two forms of accuracy (users' and producers') can be estimated from the data (Story and Congalton 1986). Users' accuracy provides an estimate of commission error, or how well spatial mapping data actually represents what is found on the ground, i.e., if the user goes to a location mapped as a certain class, what is the probability it is in fact that class? Producers' accuracy, on the other hand, measures omission error, or the probability that vegetation of a given class in the field is mapped as that class. Producers' accuracy may inform the mappers if a mapping class may be recognized on the imagery (Story and Congalton 1986, Lea and Curtis 2010).

General guidelines from the National Park Service[13] and other mapping projects in California[14] were used for this map accuracy assessment. However, with an uneven probability of accessibility and uneven mapped frequency

[12] The Ord Mountain region (approximately 8 USGS 1:24K quads) is an area of great topographic relief, including the highest elevations in the project area. It also has been highly modified through a series of recent fires, and a long history of grazing and mining. Access during reconnaissance was limited, and mapping and assessing map accuracy points proved to be challenging. Following initial mapping and review of the limited AA results, VegCAMP remapped the area around Ord Mountain using the AA field points and field observations. Because the AA points were substituted for reconnaissance points in the remapping effort, they were removed from the AA analysis.

[13] http://science.nature.nps.gov/im/inventory/veg/docs/NPSVI_Accuracy_Assessment_Guidelines_ver2.pdf

[14] http://www.dfg.ca.gov/biogeodata/vegcamp/veg_classification_reports_maps.asp

distribution for the types, it was not possible to obtain the desired minimum number of samples for each of the map units. We report all types with 5 or more users' or producers' samples in Table 5.

Table 5*: Summary of accuracy assessment.*

Results for vegetation map units with n≥5 users' or producers' samples are shown. Highlighted accuracies are less than the 80% threshold. "# Polys Mapped" refers to the number of polygons in the final map, after changes were made based on the accuracy assessment.

Map Code	Map Unit Name	Users' Count	% Users' Accuracy	Producers' Count	% Producers' Accuracy	# Polys Mapped
1122	*Juniperus californica*	46	96.5	48	95	1707
1311	*Pinus monophylla*	13	87.7	10	100	180
1411	*Populus fremontii*	20	91	22	90.9	305
1412	*Salix laevigata*	8	75	6	76.7	68
1414	*Platanus racemosa*	10	88	8	90	28
1422	*Baccharis salicifolia*	8	65	7	82.9	55
1424	*Salix exigua*	8	92.5	9	77.8	42
1425	*Forestiera pubescens*	6	86.7	7	88.6	39
1427	*Salix lasiolepis*	5	92	7	80	20
1432	*Tamarix* spp.	45	85.8	35	96	378
2111	*Arctostaphylos glauca*	7	80	2	80	45
2112	*Adenostoma fasciculatum*	16	85	25	82.4	433
2114	*Fremontodendron californicum*	3	100	5	68	81
2131	*Cercocarpus montanus*	11	92.7	11	92.7	206
2133	*Quercus berberidifolia-Adenostoma fasciculatum*	7	74.3	1	80	78
2134	*Prunus ilicifolia*	5	60	1	80	29
2215	*Eriodictyon (crassifolium, trichocalyx)*	12	81.7	9	77.8	41
2221	*Eriogonum fasciculatum*	63	75.9	73	73.7	1278
2305	Calif. Annual & Perennial Grassland (native component) Mapping Unit	45	88	34	89.4	1019
2310	CA annual forb/grass vegetation Group	9	95.6	21	85.7	82
2311	*Eschscholzia (californica)*	7	100	7	100	50
2312	*Amsinckia (menziesii, tessellata)*	0	n/a	8	95	12
2330	Medit. CA naturalized annual & perennial grassland Group	110	80.7	58	89	1107
2331	*Brassica nigra* & other mustards	3	73.3	5	100	12
3312	*Quercus john-tuckeri*	25	86.4	26	89.2	544
3412	*Schoenoplectus(acutus, californicus)* spp. Mapping Unit	6	83.3	3	86.7	55
3415	*Typha (angustifolia, domingensis, latifolia)*	11	81.8	10	96	44
3721	*Allenrolfea occidentalis*	10	90	9	95.6	76
3722	*Atriplex lentiformis*	4	65	7	54.3	24
3723	*Atriplex spinifera*	67	79.4	71	80	1568
3725	*Suaeda moquinii*	57	80.7	51	83.1	658
3726	*Distichlis spicata*	2	100	5	72	26

Map Code	Map Unit Name	Users' Count	% Users' Accuracy	Producers' Count	% Producers' Accuracy	# Polys Mapped
4111	*Ambrosia dumosa*	134	72.2	80	78	1896
4113	*Atriplex polycarpa*	136	81	163	78.5	2179
4114	*Encelia farinosa*	45	91.6	37	89.2	391
4115	*Larrea tridentata - Ambrosia dumosa*	221	90.1	304	84.9	4044
4118	*Larrea tridentata - Encelia farinosa*	114	86	72	88.3	1395
4119	*Larrea tridentata*	250	90.5	295	86	3941
4122	*Pleuraphis rigida* Alliance	8	77.5	7	91.4	26
4151	*Viguiera parishii*	6	93.3	5	100	50
4211	*Ephedra californica*	31	80	27	85.9	170
4212	*Lepidospartum squamatum*	27	92.6	41	81	167
4213	*Ericameria paniculata*	13	78.5	9	82.2	83
4214	*Prunus fasciculata*	26	86.2	27	80	146
4215	*Brickellia incana*	4	85	5	84	16
4216	*Ambrosia salsola*	65	77.2	64	71.6	413
4217	*Artemisia tridentata* ssp. *parishii*	18	81.1	10	88	96
4221	*Pluchea sericea*	17	90.6	16	91.3	142
4222	*Prosopis glandulosa*	51	94.1	50	94.8	338
4224	*Chilopsis linearis*	23	94.8	20	96	100
4225	*Psorothamnus spinosus*	19	91.6	16	91.3	65
4226	*Acacia greggii*	15	85.3	36	80	331
4227	*Parkinsonia florida-Olneya tesota*	107	97.4	126	92.2	837
4228	*Hyptis emoryi*	39	85.1	19	92.6	244
5111	*Atriplex canescens*	68	72.4	64	76.6	662
5112	*Atriplex confertifolia*	42	73.8	41	75.6	1059
5211	*Encelia virginensis*	28	61.4	22	73.6	86
5212	*Ericameria nauseosa*	51	74.9	50	72.4	1185
5215	*Ericameria cooperi*	8	75	8	57.5	51
5311	*Artemisia tridentata*	14	78.6	15	85.3	57
5410	Intermontane deep or well-drained soil scrub Group	6	76.7	5	64	6
5411	*Grayia spinosa*	42	77.1	55	72.7	400
5412	*Krascheninnikovia lanata*	9	73.3	10	66	67
5413	*Ephedra nevadensis*	30	71.3	32	75.6	222
5415	*Salazaria mexicana*	26	63.1	17	71.8	327
5416	*Ericameria teretifolia*	12	81.7	25	72.8	126
5417	*Ephedra viridis*	11	80	10	74	142
5418	*Lycium cooperi*	4	95	6	70	14
5421	*Coleogyne ramosissima*	14	88.6	12	85	249
5422	*Purshia tridentata*	10	94	11	90.9	84
5423	*Yucca brevifolia*	71	96.3	76	94.2	1482
5424	*Yucca schidigera*	35	93.7	36	93.3	323

Map Code	Map Unit Name	Users' Count	% Users' Accuracy	Producers' Count	% Producers' Accuracy	# Polys Mapped
6110	North American warm desert bedrock cliff and outcrop Group	5	80	1	80	20
6111	*Atriplex hymenelytra*	7	91.4	21	69.5	50
6113	Mud hills sparsely vegetated ephemeral herbs (Annual *Eriogonum, Plantago,* etc.)	25	79.2	21	86.7	229
6114	Unvegetated wash and river bottom	41	91.2	32	98.1	190
6115	Massive sparsely vegetated rock outcrop	16	76.3	11	83.6	98
6116	Sparsely vegetated playa (ephemeral annuals)	49	93.1	42	97.1	1499
6117	*Chorizanthe rigida-Geraea canescens* Desert Pavement sparsely vegetated	151	88.9	117	96.4	1433
6121	*Dicoria canescens - Abronia villosa*	4	85	14	78.6	49
	Total / Average Percent	2797	83.4	2784	83.6	37470

The contingency table for this accuracy assessment is provided in Appendix G. Each column in the table represents a type as mapped by the PIs (producers); by reading down the column one can see what the field surveyors (users) assessed the mapped polygon types to be on the ground. Numbers on the diagonal are correct calls by the PIs. The table displays the numbers of assessed polygons by type, and does not include fuzzy scores. In some cases, the Final Call was to Alliance level, when the mapper was only expected to map to Group level, such as for herbaceous types. If the mapper chose the correct Group in such a case, a full score would be given, though the assessment would not show up on the diagonal indicating a correct call.

Note that the accuracy scores reported above refer to the "pre-AA" polygons that were mapped of each type. Because scoring was completed on a module-by-module basis, AIS or VegCAMP made corrections after the AA scoring for each module, including corrections to type and to polygon delineations, based on notes from the field. Because corrections were made (and in some cases systematic lessons were learned) prior to map completion, and because PIs learned from the module-by-module feedback, the accuracy of the map is higher than reported here (although to what degree cannot be determined). Table 6 provides a summary of the scores per module based on delivery dates.

Table 6*: Module accuracy summary ordered by completion dates.*

Module (in order of completion)	Producers' Accuracy	Users' Accuracy
A	81.2	81
B	82.2	83.3
D	85.7	84.9
C	86.3	83.5
VegCAMP*	79.7	80

*note: the VegCAMP module was not completed in sequence and was completed over a period of time overlapping the prior modules.

Cover class values are important in judging habitat and site quality. As a test of the level of confidence in the attributed values beyond vegetation type, comparisons were made between field-checked and attributed information for cover class values ascribed to each vegetation polygon. These included the following variables: conifer cover, hardwood cover, Joshua-tree cover, total tree cover, and total shrub cover (all coded by cover class using the system in Table 7), herbaceous cover (attributed using the system in Table 8), and exotic species cover (attributed using the system in Table 9).

Table 7*: Cover classes and codes for tree and shrub cover.*

Code	Range
0	none
1	>0-1%
2	>1-5%
3	>5-15%
4	>15-25%
5	>25-50%
6	>50-75%
7	>75-100%
9	NA

Table 8*: Cover classes and codes for herbaceous cover.*

Code	Range
1	0-2%
2	>2-15%
3	>15-40%
4	>40%
9	NA

Table 9*: Codes for exotic cover.*

Code	Range
0	No evidence of exotics visible
1	Patches of exotics visible, but cover not significant (relative cover to total <33%)
2	Exotics (particularly herbaceous) significant and cover may exceed dominant vegetation strata (relative cover <66%)
3	Stand characterized by exotics (vegetation type is "exotic") (relative cover >66%)
9	NA

The attributes of all these map variables were compared to the field-assessed cover class. Map attributes that did not agree with the field assessment were categorized by the number of cover classes by which they deviated. The most accurate estimates of cover were, in order of decreasing accuracy: conifers (5% incorrect), Joshua trees (11% incorrect), hardwoods (19% incorrect), total tree (30% incorrect), total shrub (40%), total herb (58%), and total exotic cover (58%). Even the categories with the greatest errors showed strong fidelity to errors being within 1 cover class greater or less than the field-assessed cover class. No variable had any cover class beyond the adjacent higher or lower score totaling > 7% of the total "higher than" or "lower than" error (Table 10).

Table 10*: Photointerpreted cover values versus field-assessed values.*

Table shows the number and proportion per variable of all samples that were either over- or under-estimated by one or more cover classes.

Layer Cover Class	Photointerpreted > Field Verified by Number of Cover Classes Difference							Photointerpreted < Field Verified by Number of Cover Classes Difference						
	Total >	1	2	3	4	5	6	Total <	1	2	3	4	5	Total <>
Conifer	51	45	3	2	1	0	0	96	93	2	0	1	0	147
	2%	2%	0%	0%	0%	0%	0%	3%	3%	0%	0%	0%	0%	5%
Hard-wood	188	134	26	15	8	4	1	358	316	30	7	2	3	546
	6%	5%	1%	1%	0%	0%	0%	12%	11%	1%	0%	0%	0%	19%
Joshua Tree	113	113	0	0	0	0	0	200	198	2	0	0	0	313
	4%	4%	0%	0%	0%	0%	0%	7%	7%	0%	0%	0%	0%	11%
Total Tree	340	280	27	19	9	4	1	545	498	34	7	3	3	885
	12%	10%	1%	1%	0%	0%	0%	19%	17%	1%	0%	0%	0%	30%
Shrub	639	603	31	4	1	0	0	509	414	81	12	1	1	1148
	22%	21%	1%	0%	0%	0%	0%	18%	14%	3%	0%	0%	0%	40%
Herb	547	533	14	0	0	0	0	755	661	90	4	0	0	1302
	24%	24%	1%	0%	0%	0%	0%	34%	29%	4%	0%	0%	0%	58%
Exotics	614	536	69	9	0	0	0	705	648	52	5	0	0	1319
	27%	24%	3%	0%	0%	0%	0%	31%	29%	2%	0%	0%	0%	58%

This assessment suggests that if greater accuracy is desired for cover estimates the cover classes for trees and shrubs could be much improved with the following cover class system: 1 = <1 to 5%, 2 = >5 to 25%, 3 = >25-75%, and 4 = >75%. Most of the errors tended to occur in the lower cover classes (below 25% cover), since high cover of woody plants is rare in the desert environment. It is more difficult to improve the accuracy score for herbaceous and exotic cover, since herb cover varies from year to year and season to season and since the cover classes for these categories are broader to begin with. In all the vegetation categories the mappers tended to over-estimate rather than underestimate the cover class. This slight bias is common for photointerpretation and results from the appearance of higher cover by plants when viewed from a distance than from within the stand itself. Conversely, in areas of extremely sparse vegetation (such as desert pavement) the PIs tend to underestimate the percent cover, as it's very difficult to see small individual plants on the imagery.

This analysis is confounded by a disparity of phenology between the dates of the field visits and the date of the imagery. Many field visits were in the fall and winter when foliar cover varies from the peak phenology of the 2010 imagery (Table 11). As a result, it should be expected that there would not always be a high correlation between mapped and sampled cover class values, especially in deciduous woody vegetation and in annual herb cover.

Table 11: ***Dates and modules covered in VegCAMP's and CNPS' accuracy assessment field trips.***

Dates	Modules
Oct 10-14, 2011	VegCamp
Oct 24-28, 2011	A
Nov 7-11, 2011	A
Nov 14-16, 2011	A
Dec 12-16, 2011	A
Jan 17-20, 2012	VegCamp
Jan 30-Feb 3, 2012	B, VegCamp
Feb 13-17, 2012	D
Feb 27-Mar 2, 2012	D, VegCamp
Mar 12-16, 2012	B, VegCamp
Mar 26-29, 2012	VegCamp
Apr 2-6, 2012	C
Apr 9-13, 2012	C
Apr 23-27, 2012	D
Apr 30-May 4, 2012	C
May 7-11, 2012	C
May 7-11, 2012	D, VegCamp
May 21-25, 2012	D
Jun 4-8, 2012	D
Jun 11-15, 2012	D
Oct 1-5, 2012	C
Oct 15-19, 2012	C
Oct 22-26, 2012	C

Dates	Modules
Oct 29-Nov 2, 2012	C
Nov 5-9, 2012	C
Nov 26-30, 2012	C
Dec 12-14, 2012	C

In addition to polygons that were assessed for accuracy, 5,471 (11.6%) of all mapped polygons were field assessed through stand-based Rapid Assessment data collection or reconnaissance visits, thus contributing to the reliability of the map.

DISCUSSION AND CONCLUSION

Vegetation types with average scores <80% for users' or producers' accuracy are shown in Table 12.

Table 12*: Accuracy for types with users' or producers' scores (or both) < 80%.*

Total polygons mapped, percent fuzzy accuracy and count for users' and producers' accuracy for each of the map units with 5 or more user or producer assessments.

Map Unit Name	Users' Count	Users' Accuracy	Producers' Count	Producers' Accuracy	# Polygons Mapped
Salix laevigata	8	75	6	76.7	68
Baccharis salicifolia	8	65	7	82.9	55
Salix exigua	8	92.5	9	77.8	42
Fremontodendron californicum	3	100	5	68	81
Quercus berberidifolia- Adenostoma fasciculatum	7	74.3	1	80	78
Prunus ilicifolia	5	60	1	80	29
Eriodictyon (crassifolium, trichocalyx)	12	81.7	9	77.8	41
Eriogonum fasciculatum	63	75.9	73	73.7	1278
Brassica nigra & other mustards	3	73.3	5	100	12
Atriplex lentiformis	4	65	7	54.3	24
Atriplex spinifera	67	79.4	71	80	1568
Distichlis spicata	2	100	5	72	26
Ambrosia dumosa	134	72.2	80	78	1896
Atriplex polycarpa	136	81	163	78.5	2179
Pleuraphis rigida Alliance	8	77.5	7	91.4	26
Ericameria paniculata	13	78.5	9	82.2	83
Ambrosia salsola	65	77.2	64	71.6	413
Atriplex canescens	68	72.4	64	76.6	662
Atriplex confertifolia	42	73.8	41	75.6	1059
Encelia (actoni, virginensis)	28	61.4	22	73.6	86
Ericameria nauseosa	51	74.9	50	72.4	1185
Ericameria cooperi	8	75	8	57.5	51
Artemisia tridentata	14	78.6	15	85.3	57
Intermontane deep or well-drained soil scrub Group	6	76.7	5	64	6
Grayia spinosa	42	77.1	55	72.7	400
Krascheninnikovia lanata	9	73.3	10	66	67
Ephedra nevadensis	30	71.3	32	75.6	222
Salazaria mexicana	26	63.1	17	71.8	327
Ericameria teretifolia	12	81.7	25	72.8	126
Ephedra viridis	11	80	10	74	142
Lycium cooperi	4	95	6	70	14
Atriplex hymenelytra	7	91.4	21	69.5	50

Map Unit Name	Users' Count	Users' Accuracy	Producers' Count	Producers' Accuracy	# Polygons Mapped
Mud hills sparsely vegetated ephemeral herbs (Annual *Eriogonum, Plantago,* etc.)	25	79.2	21	86.7	229
Massive sparsely vegetated rock outcrop	16	76.3	11	83.6	98
Dicoria canescens - Abronia villosa	4	85	14	78.6	49

Figure 11 is a condensed image of the accuracy assessment contingency table (Appendix G) showing the intersection of the scores for the 35 types receiving below 80% users' or producers' accuracy. The mapped vegetation units receiving an average of < 80% accuracy are displayed in order of their arrangement within the NVC hierarchy.

Figure 11*: Overview of AA contingency table.*

Types with users' or producers' accuracy lower than 80% and n≥5 samples are highlighted in gold.

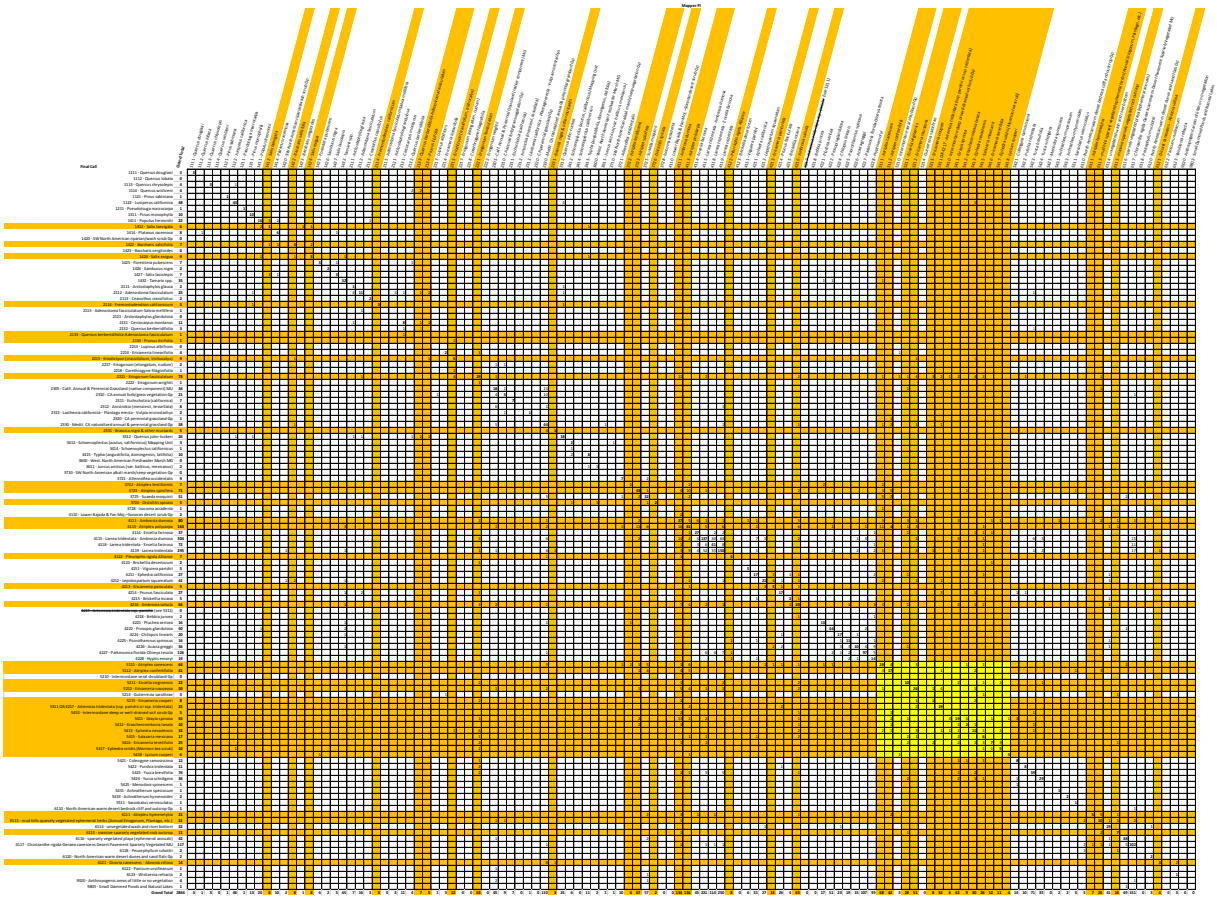


Figure 12*: Detail of the lower right area shown in Figure 11.*

Codes 5211-5311 are members of the Intermontane seral shrubland Group, and 5410-5418 are members of the Intermontane deep or well-drained soil scrub Group.

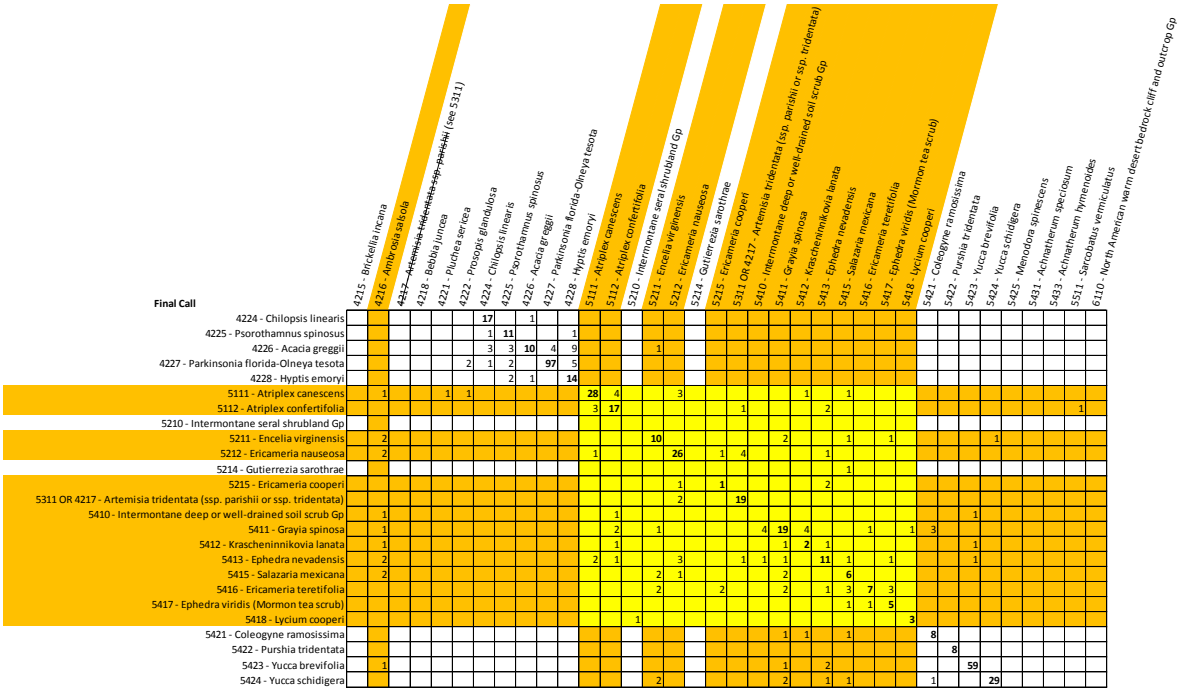


Figure 12 is a detailed view of the lower right corner of the contingency table. This part of the table is dominated by 13 types in three Groups of related Alliances characteristic of the middle and upper elevation portions of the mapping area. These three Groups account for 37% of all types receiving an accuracy of < 80%: Intermontane deep or well-drained soil scrub, Intermontane seral shrubland, and Shadscale - saltbush cool semi-desert scrub. By definition, all members of the same Group share many ecological traits. They tend to occupy areas of similar elevation and precipitation. The Alliances in these Groups tend to recover quickly from disturbance such as fire or clearing. Several Alliances are similar in appearance (e.g., all *Ericameria* spp., *Atriplex* shrubs, *Grayia* and *Krascheninnikovia*). Many of these mid-elevation vegetation types have been burned repeatedly (largely due to relatively high cover of non-native grasses, which persists as flashy fuels in these areas of relatively high precipitation) or they occur in high-reflectance areas (such as along playas) where overstory shrub type is difficult for the photointerpreters to discern.

Other Alliances receiving low scores for accuracy, and not members of the Groups discussed above, have similar issues. *Eriogonum fasciculatum* Alliance and *Ambrosia dumosa* Alliance are two problematic examples. *E. fasciculatum* has been recently identified to be a part of two distinct Alliances in the range of the mapping area. The well-understood coastal California Alliance, which is a member of the coastal scrub Macrogroup, ranges eastward into the western edge of the Mojave and Sonoran Deserts. However, there is also a desert Alliance, in which *E. fasciculatum* (often the desert varieties) frequently shares dominance with *Viguiera (Bahiopsis) parishii.* This Alliance

occurs in the central and eastern Mojave southward into the mountains of the adjacent western Sonoran Desert. Both types occur in the study area and are ecologically different. However, only one was understood conceptually at the inception of this project, thus mapping rules were more focused on the older established "coastal" version. In the desert hills and mountains, Alliances mapped as *E. fasciculatum* were sometimes found to be the following map units: 5413 - *Ephedra nevadensis*, 5415 - *Salazaria mexicana*, 5416 - *Ericameria teretifolia*, and 5417 - *Ephedra viridis*.

Ambrosia dumosa is another problematic Alliance that has broad ecological amplitude and tends to be misinterpreted in the western Mojave, where it overlaps with *Eriogonum fasciculatum*, *Grayia spinosa*, and *Atriplex polycarpa*. For example, 13 samples called *A. dumosa* by the mappers were found to be *Grayia spinosa* by the field assessment. Interestingly, *Ambrosia dumosa* is a short-lived shrub which tends to colonize areas rapidly following anthropogenic clearing. Predictability of desert vegetation by PIs tends to diminish with frequent and fine-scale patch dynamics such as those caused by fire or clearing.

Such situations as above are indicative of problems with classification concepts. Formal numerical classification results for this part of the vegetation gradient in the cooler upper Mojave Desert have not been well described (see Thomas *et al.* 2004 or Keeler-Wolf 2007). Perhaps we have tended to define vegetation types too finely in this zone based on local and short-lived dominance following recolonization.

Fremontodendron californicum is a rare vegetation type that occurs in a matrix of desert edge vegetation types, including *Pinus monophylla* and *Quercus john-tuckeri*. The photointerpreters attributed one stand of *Fremontodendron* as the former, and one as the latter, which is understandable given the rarity of *Fremontodendron californicum.*

Eight polygons of *Dicoria canescens – Abronia villosa* Alliance were mapped as 2330 - Medit. CA naturalized annual & perennial grassland Group and one mapped to Brassica nigra and other mustards. The default dune signature would be *Dicoria canescens – Abronia villosa*, but photointerpreters likely thought the dunes were too disturbed to support the native type. Two stands of *Dicoria canescens – Abronia villosa* were mapped as 6123 - *Wislizenia refracta. Wislizenia refracta* may have similar signature, but is a rare type and so the photointerpreters may not have had enough experience distinguishing the two types.

Despite the issues addressed above, the broad distribution of the AA surveys and resulting overall accuracy are indications of the final map's validity. The map met or exceeded expectations of 80% accuracy, the preferred accuracy for fine-scale vegetation mapping products, in most cases. Additionally, the majority of all tested cover values was within 1 cover-class of accuracy.

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Appendix A

CNPS and CDFW Combined Vegetation Rapid Assessment and Relevé Field Form and Protocol

CNPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

Relevé or Rapid Assessment (circle one) (Desert Version Revised March 7, 2011)

For Office Use:	**Final database #:**	**Final vegetation type name:**	**Alliance**_____ **Association**

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	**Air photo:**	**Date:**	**Name(s) of surveyors (circle recorder):**

GPS wypt #: _____ **GPS name:** _____ **Datum:** _____ **or NAD83. Bearing, left axis at SW pt**_____ **(degrees) of Long / Short side**

UTME ___ ___ ___ ___ ___ ___ **UTMN** ___ ___ ___ ___ ___ ___ ___ **Zone: 10 / 11** (circle one) **Error: ±**_____ **ft / m / pdop**

GPS within stand? Yes / No If No, cite from waypoint to stand, distance _____**(meters) & bearing** _____**(degrees)**

Elevation: **ft / m Camera Name/Photograph #'s**:

Stand Size (acres): <1, 1-5, >5 | Plot Size (m^2): 10 / 100 / 400 / 1000 | Plot Shape ___ **x**___ **ft / m or Circle Radius**____**ft / m**

Exposure, Actual °: _____ **NE NW SE SW Flat Variable All | Steepness, Actual °:** _____ **0° 1-5° 5-25° > 25**

Topography: Macro: top upper mid lower bottom | Micro: convex flat concave undulating

Geology code: _____ **Soil Texture code:** _____ **| Upland** or **Wetland/Riparian** (circle one)

% Surface cover: (Incl. outcrops) (>60cm diam) (25-60cm) (7.5-25cm) (2mm-7.5cm) (Incl sand, mud)

H20:____ **BA Stems:**____ **Litter:** ____ **Bedrock:**____ **Boulder:**____ **Stone:**____ **Cobble:**____ **Gravel:**____ **Fines:**____ **=100%**

% Current year bioturbation _____ **Past bioturbation present? Yes / No | % Hoof punch** _____

Fire evidence: Yes / No (circle one) If yes, describe in Site history section, including date of fire, if known.

Site history, stand age, comments:

Disturbance code / Intensity (L,M,H): _____/____ _____/____ _____/____ _____/____ _____/____ **"Other"** _____ / ____

II. HABITAT AND VEGETATION DESCRIPTION

Tree DBH : 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)

Shrub: S1 seedling (<3 yr. old), **S2** young (<1% dead), **S3** mature (1-25% dead), **S4** decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), **H2** (>12" ht.) **Desert Riparian Tree/Shrub: 1** (<2ft. stem ht.), **2** (2-10ft. ht.), **3** (10-20ft. ht.), **4** (>20ft. ht.)

Desert Palm/Joshua Tree: 1 (<1.5" base diameter), **2** (1.5-6" diam.), **3** (>6" diam.) **% NonVasc cover:**____ **Total % Veg cover:**_____

% Cover - Conifer tree / Hardwood tree: _____/_____ **Regenerating Tree:** _____ **Shrub:** _____ **Herbaceous:** _____

Height Class - Conifer tree / Hardwood tree: _____/_____ **Regenerating Tree:** _____ **Shrub:** _____ **Herbaceous:** _____

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species, Stratum, and % cover. Stratum categories: T=Tree, S = Shrub, H= Herb, E = SEedling, A = SApling, N= Non-vascular.
% cover intervals for reference: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, 75%.

Strata	Species	% cover	C	Strata	Species	% cover	C

Unusual species: _____

III. INTERPRETATION OF STAND

Field-assessed vegetation alliance name: _____

Field-assessed association name (optional): _____

Adjacent alliances/direction: _____/_____, _____/_____

Confidence in alliance identification: L M H Explain: _____

Phenology (E,P,L): Herb____ **Shrub**____ **Tree**____ **Other identification or mapping information:**

Is poly >1 type: Yes / No If yes, explain:

NPS and CDFG Combined Vegetation Rapid Assessment and Relevé Field Form

RELEVE SPECIES SHEET (Revised 3/22/2010)

Page _______ of Polygon/Stand #: ____________

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

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

Strata	Vascular plant name or lichen/bryophyte	% Cover	Collection	Final species determination (or DBH)

CALIFORNIA NATIVE PLANT SOCIETY / DEPARTMENT OF FISH AND GAME PROTOCOL FOR COMBINED VEGETATION RAPID ASSESSMENT

AND RELEVÉ SAMPLING FIELD FORM
(Modified for DRECP)

Introduction

This protocol describes the methodology for both the relevé and rapid assessment vegetation sampling techniques as recorded in the combined relevé and rapid assessment field survey form dated March 22, 2010. The same environmental data are collected for both techniques. However, the relevé sample is plot-based, with each species in the plot and its cover being recorded. The rapid assessment sample is based not on a plot but on the entire stand, with 12-20 of the dominant or characteristic species and their cover values recorded. For more background on the relevé and rapid assessment sampling methods, see the relevé and rapid assessment protocols at www.cnps.org.

Selecting stands to sample:

To start either the relevé or rapid assessment method, a stand of vegetation needs to be defined.
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 alpine meadow or tundra types, and some may be several square kilometers in size, such as desert or forest types. 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).

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

Depending on the project goals, you may want to select just one or a few representative stands of each homogeneous vegetation type for sampling (*e.g.*, for developing a classification for a vegetation mapping project), or you may want to sample all of them (*e.g.*, to define a rare vegetation type and/or compare site quality between the few remaining stands).

For the rapid assessment method, you will collect data based on the entire stand.

Selecting a plot to sample within in a stand (for relevés only):

Because many stands are large, it may be difficult to summarize the species composition, cover, and structure of an entire stand. We are also 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 vegetation stand, the main point to remember 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 plot 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 many cases 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.

Plot Size
All relevés of the same type of vegetation to be analyzed in a study need to be the same size. Plot shape and size are somewhat dependent on the type of vegetation under study. Therefore, general guidelines for plot sizes of tree-, shrub-, and herbaceous communities have been established. Sufficient work has been done in temperate vegetation to be confident the following conventions will capture species richness:

Herbaceous communities: 100 sq. m plot
Special herbaceous communities, such as vernal pools, fens: 10 sq m plot
Shrublands and Riparian forest/woodlands: 400 sq. m plot
Open desert and other shrublands with widely dispersed but regularly occurring woody species: 1000 sq. m plot
Upland Forest and woodland communities: 1000 sq. m plot

Plot Shape
A relevé has no fixed shape, though plot shape should reflect the character of the stand. 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.

If we are sampling broad homogeneous stands, we would most likely choose a shape such as a circle (which has the advantage of the edges being equidistant to the center point) or a square (which can be quickly laid out using perpendicular tapes).

Definitions of fields in the protocol

Relevé or Rapid Assessment Circle the method that you are using.

LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #: Number assigned either in the field or in the office prior to sampling. It is usually denoted with a four-letter abbreviation of the sampling location and then a four-number sequential number of that locale (*e.g.* CARR0001 for Carrizo sample #1). The maximum number of letters/numbers is eight.

Air photo #: The number given to the aerial photo in a vegetation-mapping project, for which photo interpreters have already done photo interpretation and delineations of polygons. If the sample site has not been photo-interpreted, leave blank.

Date: Date of the sampling.

Name(s) of 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. Please note: The person recording the data on the form should circle their name/initials.

GPS waypoint #: The waypoint number assigned by a Global Positioning System (GPS) unit when marking and storing a waypoint for the sample location. Stored points should be downloaded in the office to serve as a check on the written points and to enter into a GIS.

For relevé plots, take the waypoint in the southwest corner of the plot or in the center of a circular plot.

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

Datum: (NAD 83) The standard GPS datum used is NAD 83. If you are using a different datum, note it here.

Bearing, left axis at SW pt (note in degrees) of Long or Short side: For square or rectangular plots: from the SW corner (= the GPS point location), 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 circular or square plots). If there are no stand constraints, you would choose a circular or square plot and straight-sided plots should be set up with boundaries running in the cardinal directions. If you choose a rectangular plot that is not constrained by the stand dimensions, the short side should run from east to west, while the long side should run from north to south.

UTM coordinates: Easting (UTME) and northing (UTMN) location coordinates using the Universal Transverse Mercator (UTM) grid. Record in writing the information from a GPS unit or a USGS topographic map.

UTM zone: Universal Transverse Mercator zone. Zone 10 is for California west of the 120th longitude, zone 11 is for California east of 120th longitude, which is the same as the straight portion of California's eastern boundary.

Error: ± The accuracy of the GPS location, when taking the UTM field reading. Please record the error units by circling feet (ft), meters (m), or positional dilution of precision (pdop). If your GPS does not determine error, insert N/A in this field.

Is 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 No, cite from waypoint to stand, distance (note in meters) & bearing (note in degrees): An estimate of the number of meters and the compass bearing from the GPS waypoint to the stand.

Elevation: Recorded from the GPS unit or USGS topographic map. Please circle feet (ft) or meters (m).

Photograph #s: Write the name or initials of the camera owner, JPG/frame number, and direction of photos (note the roll number if using film). *Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the GPS location.* If additional photos are taken in other directions, please note this information on the form.

Stand Size: Estimate the size of the entire stand in which the sample is taken. As a measure, one acre is about 4000 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 the size of the plot.

Plot Shape: Record the length and width of the plot and circle measurement units (i.e., ft or m). If it is a circular plot, enter radius (or just put a check mark in the space).

Exposure: (Enter actual º and circle general category): With your back to the general uphill direction of the slope (i.e., by facing downhill of the slope), 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. Select "all" if stand is on top of a knoll that slopes in all directions or if the same, homogenous stand of vegetation occurs across all ranges of slope.

Steepness: (Enter actual º and circle general category): Read degree slope from a compass or clinometer. 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: Geological parent material of site. If exact type is unknown, use a more general category (*e.g.*, igneous, metamorphic, sedimentary). *See code list for types.*

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

Upland or Wetland/Riparian (circle one): Indicate if the stand is in an upland or a wetland. There are only two options. 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 (abiotic substrates). 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. **The total should sum to 100%.** Note that non-vascular cover (lichens, mosses, cryptobiotic crusts) is not estimated in this section.

% Water: Estimate the percent surface cover of running or standing water, ignoring the substrate below the water.
% BA Stems: Percent surface cover of the plant basal area, *i.e.*, the basal area of stems at the ground surface. Note that 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.
% Boulders: Percent surface cover of rocks > 60 cm in diameter.
% Stone: Percent surface cover of rocks 25-60 cm in diameter.
% Cobble: Percent surface cover of rocks 7.5 to 25 cm in diameter.
% Gravel: Percent surface cover of rocks 2 mm to 7.5 cm in diameter.
% Fines: Percent surface cover of bare ground and fine sediment (e.g. dirt) < 2 mm in diameter.

% Current year bioturbation: Estimate the percent of the sample or stand exhibiting soil disturbance by fossorial organisms (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.

% Hoof punch: Note the percent of the sample or stand surface that has been punched down by hooves (cattle or native grazers) in wet soil.

Fire Evidence: Circle Yes if there is visible evidence of fire, and note the type of evidence in the "Site history, stand age and 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, and comments: Briefly describe the stand age/seral stage, disturbance history, nature and extent of land use, and other site environmental and vegetation factors. 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. Characterize each impact each as **L** (=Light), **M** (=Moderate), or **H** (=Heavy). For invasive exotics, divide the total exotic cover (e.g. 25% Bromus diandrus + 8% Bromus madritensis + 5% Centaurea melitensis = 38% total exotics) by the total % cover of all the layers when added up (e.g. 15% tree + 5% low tree + 25% shrub + 40% herbs = 85% total) and multiply by 100 to get the % relative cover of exotics (e.g. 38% total exotics/85% total cover = 45% relative exotic cover). L = 0-33% *relative* cover of exotics; M =34-66% relative cover, and H = > 66% relative cover. *See code list for impacts.*

II. HABITAT AND VEGETATION DESCRIPTION

California Wildlife-Habitat Relationships (CWHR)

For CWHR, identify the size/height class of the stand 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 percent 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 if there are some larger tree dbh's. The "**T6 multi-layered**" dbh size class contains 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 or 4 (>11-24" dbh).

Shrub: Circle one of the shrub size classes provided when shrub canopy closure exceeds 10 percent (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).

Herb: Circle one of the herb height classes when herbaceous cover exceeds 2 percent 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.*

Desert Palm/Joshua Tree: Circle one of the palm or Joshua tree size classes by averaging all the stem-base diameters (*i.e.* mean diameter of all stem-base sizes). Diameter is measured at the plant's base above the bulge near the ground.

Desert Riparian Tree/Shrub: Circle one of the size classes by measuring mean stem height (whether tree and/or shrub stand).

Overall Cover of Vegetation

Provide an estimate of cover for the following categories below (based on functional life forms). 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 cover (how much of the sky can you see when you are standing under the canopy of a tree, or how much light passes through the canopy of the shrub layer?).

To come up with a specific number estimate for percent cover, first use generalized cover classes as reference aids such as the CWHR cover classes (<2%, 2-9%, 10-24%, 25-39%, 40-59%, 60-100%) or the modified Braun-Blanquet cover-abundance scale (<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%). While keeping these intervals in mind, you can then refine your estimate to a specific percentage for each category below.

% Total NonVasc cover: The total cover of all lichens, bryophytes (mosses, liverworts, hornworts), and cryptogrammic 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. This is an estimate of the absolute vegetation cover, disregarding overlap 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 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 of individual recruits. See seedling and sapling definitions below.

%Shrub: The total foliar cover (considering porosity) of all live shrub species disregarding overlap of individual shrubs.

%Herbaceous: The total cover (considering porosity) of all herbaceous species, disregarding overlap of individual herbs.

Height Class by Layer

Modal height for conifer tree /hardwood tree, shrub, and herbaceous categories: Provide an estimate of height for each category listed. Record an average height value per each category by estimating the mean height for each group. Please use the following height intervals to record a height class: 01 =< 1/2m, 02=1/2-1m, 03 = 1-2 m, 04 = 2-5 m, 05 = 5-10 m, 06 = 10-15 m,
07 = 15-20 m, 08 = 20-35 m, 09 = 35-50 m, 10 => 50m.

Species List and Coverage

For rapid assessments, list the 10-20 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.

For relevés, list all species present in the plot, using the second species list page if necessary.

For both sample types, provide the stratum:
T = 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.
E = SEedling. A tree species clearly of a very young age that is < 1" dbh.
A = SApling. 1" - <6" dbh and young in age, OR small trees that are < 1"diameter at breast height, are clearly of appreciable age, and kept short by repeated browsing, burning, or other disturbance.
N = Non-vascular. Includes moss, lichen, liverworts, hornworts, cryptogammic 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/E/A	Quercus douglasii	40/<1/<1	

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, the "C" in the collection column should crossed out. 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).

Use Jepson Manual nomenclature. Write out the genus and species of the plant. Do not abbreviate. 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 aerial cover for each species listed. 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, then 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. Note their species, if known, in the "Stand history, stand age and comments" section.

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, you can record the <1% cover in two categories: r = trace (i.e., rare in plot, or solitary individuals) and + = <1% (few individuals at < 1% cover, but common in the plot).

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.

INTERPRETATION OF STAND

Field-assessed vegetation alliance name: Name of alliance or habitat following the most recent CNPS classification system or the Manual of California Vegetation (Sawyer J.O., Keeler-Wolf T., and Evens, J. 2009). Please use scientific nomenclature, *e.g., Quercus agrifolia* forest. An alliance is based on the dominant or diagnostic species of the stand, and is usually of 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.

Please note: 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 MCVII under the explanation for "Confidence in alliance identification."

Field-assessed association name (optional): Name of the species in the alliance and additional dominant/diagnostic species from any strata, as according to CNPS classification. 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)*.

Please note: 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 away in meters from the GPS waypoint and the direction in degrees aspect that the adjacent alliance is found
(e.g., *Amsinckia tessellata* / 50m, 360° N *Eriogonum fasciculatum* /100m, 110°).

Confidence in 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 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.

Other identification problems or mapping issues: 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. If it does, how much of the likely mapping unit would be comprised of this type. For example: "this sample represents the top of kangaroo rat precincts in this general area, which are surrounded by vegetation represented by CARR000x; this type makes up 10% of the mapping unit."

Is polygon >1 type: Yes / No (circle one): *In areas that have been delineated as polygons on aerial photographs/imagery for a vegetation-mapping project,* assess if the polygon is mapped as a single stand. "Yes" is noted when the polygon delineated contains the field-assessed alliance and other vegetation type(s), as based on species composition and structure. "No" is noted when the polygon is primarily representative of the field-assessed alliance.

If yes, explain: If "Yes" above, explain the other vegetation alliances that are included within the polygon, and explain the amount and location that they cover in the polygon.

Appendix B

Hierarchical Mapping Classification for the DRECP Vegetation Map

Notes: Yellow shading refers to 1 acre MMU, green to 2.5 acre MMU
* indicates a map unit that was not in the final geodatabase
# indicates a Group level code value that was assigned as a broader code for a given polygon in the final geodatabase

1000 = TEMPERATE FOREST SUBCLASS

1100 = California Forest and Woodland Macrogroup MG009
- 1110 = Californian broadleaf forest and woodland Group
  - 1111 = *Quercus douglasii* (Blue oak woodland) Alliance
  - 1112 = *Quercus lobata* (Valley oak woodland) Alliance
  - 1113 = *Quercus chrysolepis* (Canyon live oak forest) Alliance
  - 1114 = *Quercus wislizeni* (Interior live oak woodland) Alliance
  - *1115 = *Juglans californica* (California walnut groves) Alliance
  - 1116 = *Aesculus californica* (California buckeye groves) Alliance
  - 1117 = *Quercus agrifolia* (Coast live oak woodland) Alliance
- 1120 = Californian evergreen coniferous forest and woodland Group
  - 1121 = *Pinus sabiniana* (Foothill pine woodland) Alliance
  - 1122 = *Juniperus californica* (California juniper woodland) Alliance

1200 = Californian-Vancouverian Montane and Foothill Forest Macrogroup MG023
- 1210 = Californian montane conifer forest Group
  - 1211 = *Pseudotsuga macrocarpa* (Bigcone Douglas-fir) Alliance

1300 = Intermountain Basins Pinyon-Juniper Woodland Macrogroup MG026
- 1310 = Western Great Basin montane conifer woodland Group
  - 1311 = *Pinus monophylla* (Singleleaf pinyon woodland) Alliance

1400 = Southwestern North American Riparian, Flooded and Swamp Forest Macrogroup MG036
- 1410 = Southwestern North American riparian evergreen and deciduous woodland Group
  - 1411 = *Populus fremontii* (Fremont cottonwood forest) Alliance
  - 1412 = *Salix laevigata* (Red willow thickets) Alliance
  - *1413 = *Salix gooddingii* (Black willow thickets) Alliance
  - 1414 = *Platanus racemosa* (California sycamore woodlands) Alliance
  - *1415 = *Washingtonia filifera (*California fan palm oasis) Alliance
- 1420 = Southwestern North American riparian/wash scrub Group
  - *1421 = *Baccharis emoryi* (Emory's baccharis thickets) Provisional Alliance
  - 1422 = *Baccharis salicifolia* (Mulefat thickets) Alliance
  - 1423 = *Baccharis sergiloides* (Broom baccharis thickets) Alliance
  - 1424 = *Salix exigua* (Sandbar willow thickets) Alliance
  - 1425 = *Forestiera pubescens* (Desert olive patches) Alliance
  - 1426 = *Sambucus nigra* (Blue elderberry stands) Alliance
  - 1427 = *Salix lasiolepis* (Arroyo willow thickets) Alliance
- 1430 = Southwestern North American introduced riparian scrub Group
  - 1431 = *Arundo donax* (Giant reed breaks) Semi-natural Stands
  - 1432 = *Tamarix spp.* (Tamarisk thickets) Semi-natural Stands

1500 = Western Cordilleran Montane-Boreal Riparian Scrub and Forest Macrogroup MG034

1510 = Vancouverian riparian deciduous forest Group

1511 = *Alnus rhombifolia* (White alder groves) Forest Alliance

2000 = MESOMORPHIC SHRUB AND HERB CLASS

2100 = California Chaparral Macrogroup MG043

2110 = Californian xeric chaparral Group

2111 = *Arctostaphylos glauca* (Bigberry manzanita chaparral) Alliance

2112 = *Adenostoma fasciculatum* (Chamise) Alliance

2113 = *Ceanothus crassifolius* (Hoary leaf ceanothus chaparral) Alliance

2114 = *Fremontodendron californicum* (flannelbush scrub) Alliance

2115 = *Adenostoma fasciculatum – Salvia mellifera* (Chamise-black sage chaparral) Alliance

2120 = Californian pre-montane chaparral Group

2121 = *Arctostaphylos glandulosa* (Eastwood manzanita) Alliance

2122 = *Ceanothus leucodermis* (Chaparral whitethorn) Alliance

2130= Californian mesic chaparral Group

2131 = *Cercocarpus montanus* (Birchleaf mountain mahogany) Alliance

2132 = *Quercus berberidifolia* (Scrub oak chaparral) Alliance

2133 = *Quercus berberidifolia – Adenostoma fasciculatum* (Scrub oak-chamise chaparral) Alliance

2134 = *Prunus ilicifolia* (Holly leaf cherry chaparral) Alliance

2200 = California Coastal Scrub Macrogroup MG044

2210 = Central and south coastal California seral scrub Group

*2211 = *Gutierrezia californica* (California match weed patches) Provisional Alliance

*2212 = *Lotus scoparius* (Deer weed scrub) Alliance

*2213 = *Lupinus albifrons* (Silver bush lupine scrub) Alliance

2214 = *Ericameria linearifolia – Isomeris arborea* (Narrowleaf goldenbush-bladderpod scrub) Alliance

2215 = *Eriodictyon (crassifolium, trichocalyx)* (Thick leaf and hairy yerba santa scrub) Provisional Alliance

*2216 = *Malacothamnus fasciculatus* (Bush mallow scrub) Alliance

*2217 = *Eriogonum (elongatum, nudum)* (Longstem buckwheat) Provisional Alliance

2218 = *Corethrogyne filaginifolia* (Common sand-aster scrub) Alliance

2220 = Central and South Coastal Californian coastal sage scrub Group

2221 = *Eriogonum fasciculatum* (California buckwheat scrub) Alliance

2222 = *Eriogonum wrightii* (Wright's buckwheat patches) Alliance

*2223 = *Salvia mellifera (*Black sage scrub) Alliance

2300 = California Annual and Perennial Grassland Macrogroup MG045

2305 = California annual and perennial grassland Mapping Unit (Native component)

#2310 = California annual forb/grass vegetation Group

2311 = *Eschscholzia (californica)* (California poppy fields) Alliance

2312 = *Amsinckia (menziesii, tessellata)* (Fiddleneck fields) Alliance

2313 = *Lasthenia californica - Plantago erecta - Vulpia microstachys* (California goldfields - Dwarf plantain - Six-weeks fescue flower fields) Alliance

*2314 = *Monolopia (lanceolata)-Coreopsis (calliopsidea)* (Monolopia and Tickseed) Alliance

*2315 = *Plagiobothrys nothofulvus* (Popcorn flower fields) Alliance

2320 = California perennial grassland Group

2321 = *Nassella cernua* (Nodding needle grass grassland) Provisional Alliance

2322 = *Nassella pulchra* (Purple needle grass grassland) Alliance

#2330 = Mediterranean California naturalized annual and perennial grassland Group
2331 = *Brassica nigra* and other mustards (Upland mustards) Semi-natural Stands
*2332 = *Bromus rubens - Schismus (arabicus, barbatus)* (Red brome or Mediterranean grass grasslands) Semi-natural Stands
*2333 = *Lolium perenne* (Perennial rye grass fields) Semi-natural Stands
*2334 = *Pennisetum setaceum* (Fountain grass swards) Semi-natural Stands

3000 = TEMPERATE AND BOREAL SHRUBLAND AND GRASSLAND SUBCLASS (3000)

3100 = Western North American Temperate Grassland and Meadow Macrogroup MG048
3110 = Vancouverian and Rocky Mountain naturalized annual grassland Group
*3111 = *Bromus tectorum* (Cheatgrass grassland) Semi-natural Stand
3120 = Western dry upland perennial grassland Group
*3121 = *Elymus multisetus* (Big squirreltail patches) Provisional Alliance
*3122 = *Poa secunda* (Curly or one-sided blue grass grassland) Alliance

3200 = Western Cordilleran Montane Shrubland and Grassland Macrogroup MG049
3210= Western Cordilleran montane deciduous scrub Group
3211 = *Ribes quercetorum* (Oak gooseberry thickets) Provisional Alliance
3220 = Western Cordilleran montane moist graminoid meadow Group
*3221 = *Muhlenbergia richardsonis* (Mat muhly meadows) Provisional Alliance

3300 = Warm Interior Chaparral Macrogroup MG051
3310 = Western Mojave and Western Sonoran Desert borderland chaparral Group
*3311 = *Ceanothus greggii (*Cup leaf ceanothus chaparral) Alliance
3312 = *Quercus john-tuckeri* (Tucker oak chaparral) Alliance
*3313 = *Quercus palmeri* (Palmer oak) Alliance
3314 = *Quercus cornelius-mulleri* (Muller oak chaparral) Alliance

3400 = Western North American Freshwater Marsh Macrogroup MG073
3410 = Arid West freshwater emergent marsh Group
*3411 = *Phragmites australis* (Common reed marshes) Alliance
3412 = *Schoenoplectus (acutus,californicus)* (Hardstem bulrush, California bulrush) Mapping Unit
*3413 = *Schoenoplectus acutus* (Hardstem bulrush marsh) Alliance
3414= *Schoenoplectus californicus* (California bulrush marsh) Alliance
3415 = *Typha (angustifolia, domingensis, latifolia) (Cattail marshes) Alliance*

3500 = Western North America Vernal Pool Macrogroup MG074
#3510 = Californian mixed annual/perennial freshwater vernal pool/swale/plain bottomland Group
*3511 = *Deinandra fasciculata* (Clustered tarweed fields) Alliance

3600 = Western North America Wet Meadow and Low Shrub Carr Macrogoup MG075
3610 = Californian warm temperate marsh/seep Group
3611 = *Juncus arcticus (*var. *balticus, mexicanus)* (Baltic and Mexican rush marshes) Alliance
*3612 = *Leymus triticoides* (Creeping rye grass turfs) Alliance
*3613 = *Muhlenbergia rigens* (Deer grass beds) Alliance

3700 = Warm Semi-Desert/Mediterranean Alkali–Saline Wetland Macrogroup MG083
3710= Southwestern North American alkali marsh/seep vegetation Group
*3711 = *Spartina gracilis* (Alkali cordgrass marsh) Alliance
3712 = *Sporobolus airoides* (Alkali sacaton grassland) Alliance

*3713 = *Anemopsis californica* (Yerba mansa meadows) Alliance
*3714 = *Juncus cooperi* (Cooper's rush marsh) Alliance
3715 = *Bolboschoenus maritimus, Schoenoplectus americanus* (Salt marsh bulrush, American bulrush) Mapping Unit
3720 = Southwestern North American salt basin and high marsh Group
3721 = *Allenrolfea occidentalis* (Iodine bush scrub) Alliance
3722 = *Atriplex lentiformis* (Quailbush scrub) Alliance
3723 = *Atriplex spinifera* (Spinescale scrub) Alliance
3724 = *Frankenia salina* (Alkali heath marsh) Alliance
3725 = *Suaeda moquinii* (Bush seepweed scrub) Alliance
3726 = *Distichlis spicata* (Salt grass flats) Alliance
*3727 = *Salicornia depressa* (Pickleweed flats) Herbaceous Alliance
3728 = *Isocoma acradenia* (Alkali goldenbush) Alliance
3729 = *Atriplex parryi* (Parry's saltbush) Provisional Alliance

4000 = WARM SEMI-DESERT SCRUB AND GRASSLAND SUBCLASS

4100 = Mojavean–Sonoran Desert Scrub Macrogroup MG088
#4110 = Lower bajada and fan Mojavean–Sonoran desert scrub Group
4111 = *Ambrosia dumosa (*White bursage scrub) Alliance
4113 = *Atriplex polycarpa* (Allscale scrub) Alliance
4114 = *Encelia farinosa* (Brittle bush scrub) Alliance
4115 = *Larrea tridentata - Ambrosia dumosa* (Creosote bush - white bursage scrub) Alliance
4118 = *Larrea tridentata - Encelia farinosa* (Creosote bush - brittle bush scrub) Alliance
4119 = *Larrea tridentata* (Creosote bush scrub) Alliance
*4121 = *Tidestromia oblongifolia* (Arizona honey sweet sparse scrub) Provisional Alliance
4122 = *Pleuraphis rigida* (Big galleta shrub-steppe) Alliance
*4123 = *Brickellia desertorum* (Desert brickellbush scrub) Alliance

4150 = Arizonan upland Sonoran desert scrub Group
4151 = *Viguiera parishii* (Parish's goldeneye scrub) Alliance

4200 = Madrean Warm Semi-Desert Wash Woodland/Scrub Macrogroup MG092
4210 = Mojavean semi-desert wash scrub Group
4211 = *Ephedra californica* (California joint fir scrub) Alliance
4212 = *Lepidospartum squamatum* (Scale broom scrub) Alliance
4213 = *Ericameria paniculata* (Blackstem rabbitbrush) Alliance
4214 = *Prunus fasciculata* (Desert almond) Alliance
4215 = *Brickellia incana* (Woolly brickellia wash scrub) Provisional Alliance
4216 = *Ambrosia salsola* (Cheesebush scrub) Alliance
4217 = *Artemisia tridentata ssp. parishii* (Parish's sagebrush) Provisional Alliance
4218 = *Bebbia juncea* (Sweet-bush scrub) Provisional Alliance

4220 = Sonoran-Coloradan semi-desert wash woodland/scrub Group
4221 = *Pluchea sericea* (Arrow weed thickets) Alliance
4222 = *Prosopis glandulosa* (Mesquite bosque, mesquite thicket) Alliance
4224 = *Chilopsis linearis* (Desert willow woodland)Alliance
4225 = *Psorothamnus spinosus* (Smoke tree woodland) Alliance
4226 = *Acacia greggii (*Catclaw acacia thorn scrub) Alliance
4227 = *Parkinsonia florida-Olneya tesota* (Blue palo verde-ironwood woodland) Alliance
4228 = *Hyptis emoryi* (Desert lavender scrub) Alliance

5000 = COOL SEMI-DESERT SCRUB AND GRASS SUBCLASS

5100 = Cool Semi-Desert Alkali-Saline Flats Macrogroup MG093
5110 = Shadscale-saltbush cool semi-desert scrub Group
5111 = *Atriplex canescens* (Fourwing saltbush scrub) Alliance
5112 = *Atriplex confertifolia* (Shadscale scrub) Alliance

5200 = Cool Semi-desert wash and disturbance scrub Macrogroup MG095
5210 = Intermontane seral shrubland Group
5211 = *Encelia (actoni, virginensis)* (Acton's encelia & Virgin River brittle brush scrub) Alliance
5212 = *Ericameria nauseosa* (Rubber rabbitbrush scrub) Alliance
5214 = *Gutierrezia sarothrae* (Broom snake weed scrub) Provisional Alliance
5215 = *Ericameria cooperi* (Cooper's goldenbush) Provisional Alliance
5216 = *Dendromecon rigida* (Bush poppy scrub) Alliance

5300 = Western North America Tall Sage Shrubland and Steppe Macrogroup MG096
5310 = Inter-Mountain West mesic tall sagebrush shrubland and steppe Group
5311 = *Artemisia tridentata* (Big sagebrush) Alliance

5400 = Inter-Mountain Dry Shrubland and Grassland Macrogroup MG098
#5410 = Intermontane deep or well-drained soil scrub Group
5411 = *Grayia spinosa* (Spiny hop sage scrub) Alliance
5412 = *Krascheninnikovia lanata* (Winterfat scrubland) Alliance
5413 = *Ephedra nevadensis* (Nevada joint fir) Alliance
*5414 = *Lycium andersonii* (Anderson's boxthorn scrub) Alliance
5415 = *Salazaria mexicana* (Bladder sage scrub) Alliance
5416 = *Ericameria teretifolia* (Needleleaf rabbitbrush scrub) Alliance
5417 = *Ephedra viridis* (Mormon tea scrub) Alliance
5418 = *Lycium cooperi* (Cooper's boxthorn scrub) Provisional Alliance
5420 = Mojave and Great Basin upper bajada and toeslope Group
5421 = *Coleogyne ramosissima* (Black brush scrub) Alliance
5422 = *Purshia tridentata* (Bitter brush scrub) Alliance
5423 = *Yucca brevifolia* (Joshua tree woodland) Alliance
5424 = *Yucca schidigera* (Mojave yucca scrub) Alliance
5425 = *Menodora spinescens* (Greenfire scrub) Alliance
5430 = Southern Great Basin semi-desert grassland Group
5431 = *Achnatherum speciosum* (Desert needlegrass grassland) Alliance
*5432 = *Pleuraphis jamesii* (James' galleta shrub-steppe) Alliance
5433 = *Achnatherum hymenoides* (Indian rice grass grassland) Alliance
5440 = Intermountain shallow/calcareous soil scrub Group
5441 = *Cercocarpus ledifolius* (Curl leaf mountain mahogany scrub) Alliance

5500 = Cool Semi-Desert Alkali-Saline Wetlands Macrogroup MG082
5510 = Great Basin cool semi-desert alkali basin Group
5511 = *Sarcobatus vermiculatus* (Greasewood scrub) Alliance

6000 = NORTH AMERICAN WARM SEMI-DESERT CLIFF, SCREE AND ROCK VEGETATION DIVISION

6100 = North American Warm Semi-Desert Cliff, Scree, and Other Rock Vegetation Macrogroup MG117
6110 = North American warm desert bedrock cliff and outcrop Group
6111 = *Atriplex hymenelytra* (Desert holly scrub) Alliance
*6112 = *Ephedra funerea* (Death Valley joint fir scrub) Alliance
6113 = Mud Hills sparsely vegetated ephemeral herbs Mapping Unit

6114 = Unvegetated wash and river bottom Mapping Unit
6115 = Massive sparsely vegetated rock outcrop Mapping Unit
6116 = Sparsely vegetated playa (Ephemeral annuals) Mapping Unit
6117 = *Chorizanthe rigida-Geraea canescens* (Spiny herb-Desert gold) Desert Pavement Sparsely Vegetated Alliance
6118 = *Peucephyllum schottii* (Desert fir) Alliance
#6120 = North American warm desert dunes and sand flats Group
6121 = *Dicoria canescens - Abronia villosa* (Desert dunes) Alliance
6122 = *Panicum urvilleanum* (Desert panic grass patches) Alliance
6123 = *Wislizenia refracta* (Spectacle fruit) Special Stands

9000 = MISCELLANEOUS CLASSES

9200 = Agriculture
9210 = Woody Agriculture (orchards, vineyards)
9220 = Non-woody Row and Field Agriculture

9300 = Built-up & Urban Disturbance
9310 = Urban Window
9320 = Anthropogenic areas of little or no vegetation

#9500 = Exotic Trees
*9501 = Eucalyptus

9800 = Water
9801 = Perennial Stream Channel (Open Water)
9803 = Small Earthen-dammed Ponds and Naturally Occurring Lakes
9804 = California Aqueduct, Colorado River Aqueduct (Open Water)
9805 = Water Impoundment Feature

Appendix C

Hierarchical Field and Mapping Key to 2013 California Desert Vegetation Map in Support of the Desert Renewable Energy Conservation Plan

This key is developed for the areas mapped in support of the DRECP. It is intended for use as a guide to identification of field-based and image interpretation- based vegetation assessments.

Due to the high diversity of the vegetation communities in the area, this is a complex key. You will need to collect or refer to plant composition data that include not only those species that are dominant but also those "indicator," or characteristic species, whose presence may cause the plot to key to another vegetation type. If you are using this key for mapping rules please also note that some of the types are typically below the accurate detectability for mapping in this project.

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 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 at the scale being considered. The map has a variable Minimum Mapping Unit (MMU) size. For fine scale features such as wetlands, riparian, or playas it is 1 acre and for upland vegetation it is 10 acres. Certain types of upland vegetation are also found in washes (*i.e., Ambrosia salsola* and *Atriplex polycarpa* alliances). In these cases, vegetation is mapped at a MMU of 5 acres in order to maintain the wash vegetation features separate from surrounding upland. Special types are mapped to 1 acre. The foothills of the Transverse Ranges are mapped to 2 acres in keeping with state-wide mapping standards.

Alliance: Plant communities based on dominant/diagnostic species of uppermost or dominant stratum. Part of the National Vegetation Classification System (NVCS) hierarchy.

Association: The most botanically detailed plant community designation based on dominant species and multiple co- or subdominant indicator species from any strata. Part of the NVCS hierarchy.

Plant community nomenclature: Species separated by "-" are within the same stratum; species separated by "/" are in different strata. The number that precedes some plant community names is the Mapping Code used for labeling plant community polygons for the associated GIS-based plant community map.

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 and aerial photo interpreters are trained to estimate the amount of 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.

If there is a species present in high cover for which no type exists in the key, there are two options. First, the plot can key to another species that is present in high cover. For example, a plot with 6 percent cover *Senna armata* and 4 percent *Ambrosia salsola* would key to *Ambrosia salsola*, since there is no *Senna armata* type defined in the study area. If this is not a reasonable option, the plot can be designated "unable to key." Plots that are unable to key may be candidates for new vegetation types especially if similar stands are seen to repeat in the landscape. In addition to *Senna armata,* several other woody species may dominate a stand but may not be keyable here, including: *Tetradymia* spp. (including *T. stenolepis* and *T. fasciculatus*), *Lepidium fremontii*, and *Fraxinus velutina.* Comments are inserted in the likely places in the key to address not as yet formally designated vegetation types, which may be dominated by such species.

Absolute cover: The actual percentage of the surface area of the plot that is covered by a species or physiognomic group (trees, shrubs, herbaceous), as in "creosote bush covers 10 percent of the plot." Absolute cover of all species or physiognomic groups, when added together, may total greater than 100 percent, because this is not a proportional number and plants can overlap each other. For example, a plot could have 25 percent tree cover, 40 percent shrub cover, and 50 percent herbaceous cover.

Relative cover: The percentage of the surface area of the plot that is covered by one species or physiognomic group (trees, shrubs, herbaceous) as compared or relative to the amount of surface of the plot covered by all species or groups. Thus, 50 percent relative cover means that half of the total proportion of cover of all species or physiognomic groups is composed of the single species or group in question. Relative cover values are a proportional number that, when added together, total 100 percent for each sample or stand. For example, a creosote bush–burro bush vegetation plot with 5 percent cover creosote bush and 5 percent cover burro bush estimated using absolute cover would translate to 50 percent relative cover of creosote bush and 50 percent relative cover of burro bush.

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 creosote bush," 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 at least 70 percent of the stands of this type, with at least 50 percent relative cover in each stand, however, see "dominance by layer," below.

> **Strongly dominant: 60 percent+ relative cover.** A species in the dominant life form stratum has 60 percent or greater relative cover.
>
> **Codominant: Each species has 30 percent–60 percent relative cover.** Codominance refers to two or more species in a stand with near equal cover. In general, codominance can occur among species that have between 30 and 60 percent relative cover each. **To be codominant species** should be in at least 70 percent of the stands of this type, with at least 30 percent relative cover in each stand. For example in a desert scrub stand with 5% *Larrea tridentata*, 3% *Ambrosia dumosa*, and 4% *Ephedra nevadensis* (total 13% shrub cover), technically only the *Larrea* (5/13 = 39% relative cover) and the *Ephedra* (4/13 = 31% relative cover) would be codominant, even though the stand would key out to *Larrea tridentata – Ambrosia dumosa* alliance (see rules for *Larrea tridentata – Ambrosia dumosa* in key below.).

Consistent/Characteristic/Diagnostic species: Should be present in at least 75 percent of the stands of the type, with no restriction on cover.

Abundant species: Should be present in at least 50 percent of the samples, with an average of at least 30 percent relative cover in all samples.

Dominance by layer: Tree, shrub, and herbaceous layers are considered physiognomically distinct. A vegetation type is considered to belong to a certain physiognomic group if it is dominated by one layer. Layers are prioritized in order of height. The tallest layer, if it meets a criterion in the "characterized" definitions (see below) is said to dominate, and the type is usually named at the alliance level by the characteristic species of the tallest layer. Average covers within the dominant layer reflect the "modal" concept of the characteristics 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.

Layer dominance concepts are relative to higher levels in the classification that are driven by regional climate (usually from Macrogroup to Formation levels). This is an important concept in the mapping area where, for example, desert shrublands meet California Mediterranean climate shrublands or montane woodlands. Rules within the Mojave-Sonoran desert discuss *Yucca brevifolia* having a threshold membership rule of >1% cover with even distribution, even when *Y. brevifolia* occurs over a much more dense and evenly distributed sclerophyllous shrub cover of *Adenostoma fasciculatum* or *Quercus john-tuckeri.* This rule does not apply in a more Mediterranean Californian climate where such a stand would key to the best characteristic species of the shrub layer (e.g., *Adenostoma fasciculatum)*. In order to be keyed to a *Y. brevifolia* alliance, such a stand would have to contain at least 10% cover of *Y. brevifolia* over the sclerophyll layer, since for wetter non-desert environments the rule for tree layer dominance is ≥ 10% tree cover. This also applies to situations where *Pinus monophylla* occurs over chaparral as in portions of the foothills of the Transverse Ranges, since *P. monophylla* alliance is diagnostic of the Intermountain Singleleaf Pinyon - Western Juniper Woodland Macrogroup. Although *P. monophylla* may only need to be >1% cover in desert vegetation, it would need to be >10% when present in predominantly sclerophyllous Mediterranean scrub, which regularly has >25% shrub cover in a stand.

Plant Dispersion (sociability) in semi deserts and sparsely vegetated landscapes:
For all desert vegetation, an even distribution of species in the dominant layer is an important factor in correctly identifying alliances and associations. Whatever the dominant overstory layer, the diagnostic species in that layer should be evenly distributed across the stand being assessed. This applies to riparian stands characterized by willows, cottonwoods, and palms; desert scrub with species such as creosote bush, saltbush, or encelia; or herb-land/grassland stands with species such as *Coreopsis, Amsinckia, Eriogonum, Pleuraphis,* or *Bromus*. Therefore, when using this key in the field or with high resolution aerial imagery, it is important to assess not just the estimated cover of the diagnostic species in their layer(s), but also reflect upon their dispersion within the stand.

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, as this may only vary a few percent between diagnostic and associated species. Irregular distribution of species suggests a history of recent disturbance and makes precise determination more difficult. In some cases due to disturbance such as recent fire or clearing, desert vegetation may not be identifiable to alliance and can only be described at higher levels such as group or macrogroup. In other cases early seral vegetation also has diagnostic opportunistic species such as *Ambrosia salsola, Ericameria cooperi, E. nauseosa, or Encelia actoni.* They may quickly colonize and form stands that will begin, if left undisturbed for several years, to shift to a more stable and structurally diverse stand of a different alliance. The key is arranged in the general order of the NVCS hierarchy for situations like this; it reflects such ecological relationships.

Increaser: A plant species (usually shrubs as used in this key) that tends to increase in numbers and in relative cover following fire, prolonged grazing, or other disturbance.

Estimating cover using actual percentages, rather than cover classes, is preferable, because it gives the fullest picture of the vegetation present. It enables later review of the data to confirm the choice of plant community and may help to describe new vegetation types and answer future management or research questions. If a less rigorous and faster approach is needed, for example, if the project is not primarily a vegetation project, the following cover classes may be used:

1. <1 percent
2. 1–5 percent
3a. 6–15 percent
3b. 16–25 percent
4. 26–50 percent
5. 51–75 percent
6. 76–100 percent

All references to percent cover in the key are to absolute cover unless specified in a particular section as relative cover.

Diagnostic species: A species typically found in the dominant stratum of a vegetation type often lending its name to that association or alliance due to its constancy and reliable presence throughout most similar stands.

Sparse: Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is typically less than 2 percent absolute cover.

Sparse vegetation: Neither vascular plants nor nonvascular organisms provide a consistent structural component or play an important role in ecological processes on the site. For the desert this is usually below 2% absolute cover in combination with an irregular uneven distribution across the landscape.

Woody plant: Is any species of plant that has noticeably woody stems. It does not include herbaceous species with woody underground portions such as tubers, roots, or rhizomes.

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 ramifying after fire or other disturbance, but the size of mature plants is typically greater than 5 meters. Undisturbed individuals of these species are usually single stemmed. Certain species that resemble shrubs most of the time in our study area but may be trees in other areas (*e.g.*, *Juniperus californica*) are, out of state-wide tradition, called trees, even though conversely tall shrubs such as *Quercus john-tuckeri* may be equally as tall, but are never called trees. It behooves one to memorize which species are "traditionally" placed in one life-form or another. We use the NRCS Plants Database to do this.

Tree-characterized vegetation: Trees are evenly distributed throughout the stand. In the Mediterranean climate margins of the desert, as in the San Gabriel, San Bernardino, Sierra Pelona, Liebre, or Tehachapi Mountains, trees have typically $\geq$10 percent cover, providing a consistent structural component. In the true desert, short trees such as pinyon pine, Joshua tree, or California juniper are diagnostic at lower than 10% cover. Typically 2 or even 1 percent, of evenly distributed diagnostic tree species is all that is needed, if one or both of the following criteria are met: (1) trees influence the distribution or population dynamics of other plant species; (2) trees play an important role in ecological processes within the stand.

> **Forest:** In the NVCS, a forest is defined as a tree-dominated stand of vegetation with 60 percent or greater cover of trees. Most forest alliances tend to have average tree cover of 60 percent, but individual stands under certain conditions may drop lower than 60 percent.

Woodland: In the NVCS, woodland is defined as a tree-dominated stand of vegetation with between 25 percent and 60 percent cover of trees. The same notion of "modality" that applies to forest types also applies here and to the sparsely wooded category.

Emergent: A plant (or vegetation layer) is considered emergent if it has a low cover and rises above a layer with has most of the cover in the stand. For example, individual *Quercus lobata* trees may comprise an emergent tree layer of 5 percent over a dense layer of *Artemisia californica* shrubs; the stand would be considered within the *Artemisia californica* Shrubland Alliance because the total tree cover is < 10% and the shrub cover is >10%. Further, medium to tall shrubs are not considered emergent over shorter shrubs, but short trees are considered emergent over tall shrubs. For desert vegetation, which is inherently sparse, the threshold is lower. Trees such as pinyon pine, California juniper, and Joshua tree can be evenly distributed at as low as 1-2% and instead be considered the dominant members of the canopy because the shrub or herb vegetation cover is usually low. An emergent tree in the desert is generally not evenly distributed.

Joshua Tree and "Microphyll" "woodland". *Yucca brevifolia* is iconic and typically substantially taller than most other woody plants of the Mojave Desert. It is considered a tree even in its short clonal form, which is typical of the western desert margins. Even though woodlands outside of the desert are rarely considered such when the tree cover is less than 10%, a stand can be considered Joshua tree woodland when Joshua trees are evenly distributed and have at least 1% cover.

Colorado Desert microphyll woodland species such as *Olneya tesota* and *Parkinsonia florida,* even at their best "woodland" development, are rarely over 10% cover throughout a stand though they are visually and structurally conspicuous. They define stands, even with lower than 5% absolute cover, especially since any other component woody species typically have less cover than these trees.

Shrub: Usually a multi-stemmed woody plant that is between 0.2 meter and 5 meters tall. Definitions are blurred at the low and high ends of the height scales. At the tall end, shrubs may approach trees based on disturbance frequencies (*e.g.*, old-growth resprouting chaparral species such as *Cercocarpus montanus, Fremontodendron californica, Prunus ilicifolia,* and so forth, may frequently attain "tree size"). At the short end, woody perennial herbs or subshrubs of various species are often difficult to categorize into a consistent life-form.

Sub-shrub: A multi-stemmed plant with noticeably woody stems, typically less than 0.5 meters tall and sometimes confusable with a seemingly woody perennial herb.

Shrub-characterized vegetation: Shrubs (including sub-shrubs) 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.

Herbaceous plant: Any species of plant that has no main woody stem development and 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 play an important role in ecological processes within the stand, and the stand cannot be characterized as a tree or shrub stand.

Nonvascular vegetation: Nonvascular organisms provide a consistent (even if sparse) structural component and play an important role in ecological processes within the stand.

Botanical nomenclature: We use the NRCS PLANTS database in vegetation mapping as our standard for botanical names. A crosswalk to The Jepson Manual, 2nd Edition is provided in Appendix D.

Use of the Key

This key is constructed in a traditional dichotomous style, with couplets of opposing choices. Exceptions are in the most diverse groups where dichotomies split the main subdivisions of alliances and then a small number of associations may be simply listed below the subdivisions with diagnostic characteristics. The key is blind to any artificial division between trees, shrub, and herbaceous dominated vegetation. Instead it follows more closely the new National Vegetation Classification hierarchy (Faber-Langendoen et al. 2009) promoted by the Ecological Society of America's Vegetation Panel and the Federal Geographic Data Committee (Peet 2008).

To underscore the relationships of different vegetation in the Western Mojave, bolded text (in addition to Alliance and mapping unit names) has been inserted to show hierarchical position at important ecological breaking points given in the key. Aside from the main concepts of Alliance and Association previously mentioned above, the other hierarchy units are (from highest to lowest) are: **1. Class, 2. Subclass, 3. Formation, 4. Division, 5. Macrogroup, and 6. Group.**

The vegetation map includes some mapping units that are either human created or are not vegetation at all. These may be individuated from the natural vegetation below by using this short key, below.

KEY TO NATURAL AND ANTHROPOGENIC LAND COVER

1. Landscape unit consists of water bodies
9800 = Water

2. Open waters of naturally flowing streams and rivers…
9801 = Perennial Stream Channel (Open Water)

2'. Water either naturally contained and not flowing, or contained by anthropogenic means (canals, reservoirs or aqueducts)

3. Water contained by earthen dams and/or natural landscape features…
9803 = Small Earthen-dammed Ponds and Naturally Occurring Lakes

3'. Water contained entirely by pavement, concrete, or by human constructed earthen walls…

4. Water in the conveyance known as the California Aqueduct…
9804 = California Aqueduct, Colorado River Aqueduct (Open Water)

4'. Water surrounded on all sides by human-constructed walls…
9805 = Water Impoundment Feature

1.' Landscape is not water…

5. Landscape is heavily modified by human activity. This constitutes such things as recently planted agricultural crops, broad extents of residential and industrial buildings, and areas that have been physically denuded of vegetation. In the vegetation mapping classification these are generically termed Miscellaneous Map Classes (the "9000" codes). In the National Vegetation Classification System these would include in part the classes called Hortomorphic (gardens and other plantings for aesthetic purposes) and Agromorphic (all forms of agriculture including annual row crops, vineyards, orchards, and timber plantations)…

6. Landscape is vegetated by human-plantings for aesthetic purposes, food, fiber, or building materials production…

7. Vegetation is confined to active agriculture (defined as planted and maintained for no more than 5 years earlier than the 2010 NAIP base imagery date). May be dominated by annual or perennial types…
9200 = Agriculture (within the current 5-year cycle) (includes nurseries)

8. Vegetation defined by woody vegetation such as orchards and vineyards.
9210 = Woody Agriculture (orchards, vineyards)

8'. Vegetation defined by annual herbaceous vegetation.
9220 = Non-woody Row and Field Agriculture

7'. Vegetation confined to aesthetic horticultural plantings of trees not grown for harvest for food or other products…
9500 = Exotic Trees

9. Vegetation consisting of planted trees of the genus *Eucalyptus*…
9501 = Eucalyptus (not mapped and not inventoried in study area)

9'. Vegetation consisting of planted trees of other species…
(unit not defined for this project)

6'. Landscape is unvegetated or consists of a matrix of development and small patches of natural or human planted vegetation…
9300 = Built-up & Urban Disturbance

10. Landscape unit is not vegetated but cleared by humans…
9320 = Anthropogenic areas of little or no vegetation

10'. Landscape is defined by a minimum of 10 acres containing a matrix of buildings and small natural or anthropogenic vegetated or unvegetated opening between buildings. Commonly called suburban areas or housing developments…
9310 = Urban Window

5'. Landscape is sparsely to very well-vegetated with naturally growing (not planted and heavily tended) vegetation …
Use key to natural and semi-natural vegetation, below.

KEY TO NATURAL AND SEMI-NATURAL VEGETATION

1. Vegetation largely absent and no species are evenly distributed. Vegetation not uniformly distributed across a landscape surface, generally less than 5% cover, not composed of evenly-spaced trees or shrubs, or not characterized by herbaceous species most of the time. Following seasons of exceptional precipitation, herbaceous annual species may be abundant and evenly distributed...
Class 6 Lithomorphic Vegetation (Nonvascular and Sparse Vascular Rock Vegetation)
Subclass 6.C Semi-Desert Nonvascular and Sparse Vascular Vegetation
Formation 6.C.1 Warm Semi-Desert Cliff, Scree, and Rock Vegetation
Division 6.C.1.a North American Warm Semi-Desert Cliff, Scree, and Rock Vegetation
6100 = North American Warm Semi-Desert Cliff, Scree, and Other Rock Vegetation Macrogroup MG117
6110 = North American warm desert bedrock cliff and outcrop Group

2. Landscape characterized by open dunes, dune aprons, or sand flats. Vegetation is generally sparse to very open (<2-10% cover) except for annual blooms in favorable years. [Group - North American warm desert dunes and sand flats.] May include the following possible alliances, although local indicator species may be different (*e.g.*, *Cryptantha angustifolia, Camissonia claviformis, and Oenothera deltoides*)…

6120 = North American Warm Desert Dunes and Sand Flats Group3. *Dicoria canescens* or *Abronia villosa* (or other annual herbs) not characteristically present or present in less cover and less uniform distribution than taller perennial sand-loving herbs or grasses…

4. Stands are characterized by even, sparse distribution of the stoloniferous dune panic-grass (*Panicum urvilleanum*). Restricted locally to broad sandy riverbed and adjacent low dunes of the Mojave River from Hinkley to Camp Cady…
6122 = *Panicum urvilleanum* (Desert panic grass patches) Alliance

4'. Stands dominated by the tall perennial herb *Wislizenia refracta,* which may have as low as 1% cover. Found associated with low dunes adjacent to Palen Dry Lake, often adjacent to open stands of *Atriplex canescens* or *Suaeda moquinii)* scrubland…
6123 = *Wislizenia refracta* (Spectacle fruit) Special Stands

3'. Dunes not as above in 3. *Dicoria canescens* or *Abronia villosa* are characteristically present in stands, but are not necessarily dominant or even present, depending upon the year and the phenology of these annual plants. Skeletons of *Dicoria, Oenothera deltoides, Abronia villosa* and other psammophytic annuals are usually present. Uniform woody plant cover is <2% absolute cover and may include *Larrea tridentata, Parkinsonia florida* and *Psorothamnus emoryi*…
6121 = *Dicoria canescens - Abronia villosa* (Desert dunes) Alliance

2'. Landscape characterized by desert pavement, pediment, badlands, playa margins, or outcrops with ≤5 % cover of perennial plant species, none of which are particularly evenly distributed. During exceptional years there may be significant annual ephemeral species cover (which may be evenly distributed). Species are not always present, but on non-sand substrate can include *Plantago ovata, Cryptantha angustifolia, Chorizanthe rigida,* and *Geraea canescens,* etc...

5. Stands are characterized by very low shrub cover, and are low in total absolute cover (usually 1-5%) of all layers…

6. *Atriplex hymenelytra* usually with >1% cover or no other woody species with equal or higher cover. May occur on hot rocky slopes, dry bajadas, or alkaline badlands and playa edges. Stands are local in the extreme north of the mapped area near Ridgecrest and Trona on alkali basin sediments and more extensive in the Calico Mountains and in the Alvord

Mountains on volcanic ash and flows emanating from the southern and eastern sides of these ranges. Stands are also known from the altered volcanic hills southeast of Barstow and west of Daggett. Stands are generally considered "sparsely vegetated"; however, some stands can have up to 10% shrub cover under certain circumstances. *Larrea tridentata* often intermixes. Stands that are co-dominated by *Atriplex confertifolia* are *Atriplex confertifolia* alliance…
6111 = *Atriplex hymenelytra* (Desert holly scrub) Alliance

6'. Vegetation dominated or characterized by a low total cover of *Ephedra funerea* or *Peucephyllum schottii,* with no other indicator shrub species present in greater cover or dispersion…

7. An uncertain alliance found in calcareous mountains, or rarely, other shallow volcanic slopes in the study area. Often accompanied by *Echinocactus, Ferocactus,* or *Echinocereus* spp. One or two reconnaissance points have been taken for this alliance in the eastern portion of our study area. It has not been mapped…
6112 = *Ephedra funerea* (Death Valley joint fir scrub) Alliance (not mapped and not inventoried in study area)

7'. Stands typical of steep massive outcrops of basalt or calcareous rocks (cliffs and scree) at lower elevations throughout the study area. The bright green arborescent shrub (which may resemble *Larrea* at a distance, beware) *Peucephyllum schottii* is characteristic throughout the stand, but is often only 1-5% total cover…
6118 = *Peucephyllum schottii* (Desert fir) Alliance

5.' Stands usually do not support a sparse, even distribution of shrubs. Cover is either apparently lacking entirely, or in good precipitation years, distinguished by ephemeral blooms of annual plants. Substrates vary from hills, mountains, playas and riverbeds…

8. The substrate is low-lying with little topography; either desert playa or wash and river bed channels of sand, cobbles, silt, clay, or salty or alkaline mineral deposits…

9. This mapping unit is distinguished by largely unvegetated sands and gravels in the active centers of washes throughout the study area. Depending upon site history and recent flooding events these bare "river-wash" channels can change rapidly and regularly from unvegetated to vegetated by annual natives, to vegetated by shrub species indicative of washes of different flooding frequencies and intensities. Mapped usually as scattered shrubs and herbs with <2% average cover and uneven distribution...
6114 = Unvegetated wash and river bottom Mapping Unit

9'. This mapping unit defines silty, clay, or salt crust playa (dry lake) surfaces throughout the study area. Most of the time playas, whether salty, silty, or clay, are usually <2% vegetative cover. However, annuals such as *Monolepis nuttalliana, Atriplex elegans, A. phyllostegia,* and others may occur in good El Niño years in relatively high cover. These are still mapped as this unit. Characteristics include flat or cracked substrate and no obvious slope. Reflectance may be gray to white to light brown...
6116 = Sparsely vegetated playa (Ephemeral annuals) Mapping Unit

8'. The substrate is part of an elevated landscape that usually has hills, slopes, outcrops, or ravines…

10. The surface of the stand is usually gradually sloping, but often characterized by small cobbles or rock fragments - the result of long-term weathering of alluvial fans/bajadas at the bases of mountains. Settings are often very sparsely vegetated with few widely scattered shrubs (except in adjacent small rills and washes). Herbs are only present in high numbers following significant rainfall events. Diagnostic species of herbs, such as *Chorizanthe rigida* and *Geraea canescens*, persist as dead skeletons for many months

and can assist in proper identification, but many times especially on harsh substrates, herbaceous skeletons are lacking. In the eastern desert areas, as near the Colorado River, surfaces are often very dark with "desert varnish" due to age of exposure. Younger surfaces to the west, with slightly higher average precipitation, transition to having more regular signs of annual residual vegetation. In the western Mojave, some stands have other annuals regularly associated with them, including some non-natives such as *Bromus rubens* and *Schismus* spp. Currently the entire suite of "desert pavements" across the warm California deserts are considered members of the *Chorizanthe rigida - Geraea canescens* Alliance…
6117 = *Chorizanthe rigida-Geraea canescens* (Spiny herb-Desert gold) Desert Pavement Sparsely Vegetated Alliance

10'. Stands defined by (usually) steeply to moderately sloping landforms that can be considered hills, badlands, mountains, or outcrops of resistant rock. Vegetation is sparse or at best characterized by sporadic occurrences of ephemeral blooms of annuals following good rainfall…

11. This mapping unit is usually sparsely vegetated, often with <2% shrub cover or herb cover. Substrate is composed of unconsolidated and uncemented fine, sometimes alkaline, sediments. Strata variations make for different but typically sparsely vegetated slopes. Averaging all cover across these landscapes is usually what constitutes >10 acre mapping polygons, which consist of a matrix of small patches of shrubs or herbs at 2% interspersed with larger areas of little or no measurable cover of herbs or shrubs. Topography is often rugged and eroded ("badlands"), however, in some areas, such in the northern portion of the study area, the same species may occur on relatively flat terrain adjacent to edges of playas and in broad valleys. In many years these areas are largely unvegetated. Some have scattered *Atriplex hymenelytra, Atriplex confertifolia, Stanleya pinnata* and other woody species. In El Niño years clay slopes are heavily covered with annual *Eriogonum* species, probably most commonly *E. inflatum* (many sizes of this plant). This and other species of *Eriogonum*, along with *Plantago ovata, Chorizanthe* species, and sometimes *Lepidium lemmonii, Coreopsis calliopsidea,* and other species can lend noticeable color to these exposures…
6113 = Mud Hills sparsely vegetated ephemeral herbs Mapping Unit

11'. This mapping unit is defined by extensive solid blocks of resistant rock of any type. In our area these may be volcanic extrusives such as basalt or rhyolite; igneous intrusives such as granodiorite, gabbro, or quartz monzonite; or sedimentary sandstones or limestones, etc. Large unfractured bedrock or boulders are typical, with narrow crevices in different densities. Overall shrub and herb cover tends to be under 5%, making it difficult to distinguish any particularly dominant species. Mapping units of this type may include small (<10 acre) stands of *Ephedra viridis, Atriplex polycarpa, Encelia farinosa, Ericameria cuneatus, E. teretifolia, Salazaria mexicana, Eriogonum fasciculatum,* and other alliances. Separate this from mud hills by erosional patterns (should see individual rock outcrops, boulders, etc) in this unit…
6115 = Massive sparsely vegetated rock outcrop Mapping Unit

1'. Vegetation easily visible and ≥5 % total cover (sometimes as low as 2% if evenly distributed) and characterized by trees, shrubs and/or herbs that are evenly distributed across the stand.

12. Vegetation dominated by broad-leaved or needle-leaved trees (or if in riparian, larger winter deciduous shrubs, such as *Salix* spp.) generally over 10% absolute cover. In the California desert, tree vegetation is typically taller than the average creosote-bush (*e.g.*, >3m tall). Characteristic species of the dominant layer are either winter deciduous or evergreen and do not exhibit xeromorphic characteristics such as thorns, drought-deciduousness, succulent stems or microphyllous leaves/leaflets. If growing in the desert ecoregion, growing in arroyos, washes, canyon

bottoms, springs, seeps, or other areas that receive and retain more moisture than ambient desert settings...

1.C. Temperate Forest and Woodland Subclass

13. Vegetation is dominated by broad-leaved or needle-leaved trees or tall shrubs (such as willows). Not in uplands or dry washes, but in areas where moisture is present at least under the surface in the warmer months (near permanent surface or subsurface moisture). The majority of stands in the study area are riparian and the only truly flooded stands appear at the margins of permanent reservoirs in Palmdale and the western Antelope Valley...

Formation 1.C.3. Temperate Flooded and Swamp Forest
Division 1.C.3.c Western North America Warm Temperate Flooded and Swamp Forest
1400 = Southwestern North American Riparian, Flooded and Swamp Forest Macrogroup
MG036 (now called M036 Warm Mediterranean & Desert Riparian, Flooded & Swamp Forest)

14. Stands are dominated or characterized by riparian winter deciduous, broad-leaved trees or tall shrubs, including *Populus fremontii, Platanus racemosa,* and/or a species of *Salix.* If the tree canopy is between 5 and 10 percent absolute cover, the shrub canopy should not be more than double the tree canopy (otherwise, see 15'). Note that all diagnostics in this macrogroup and group are considered as such even as saplings when similar in size to mature individuals of shrubby *Salix,* (*e.g.,* S. *lasiolepis* and S. *exigua*.) Thus, if the stand has >threshold cover for indicators of this group as saplings, even if there is similar or greater cover of shrub willow species, the stand would key to the tree type…

1410 = Southwestern North American riparian evergreen and deciduous woodland Group

15. *Populus fremontii* is dominant or co-dominant, usually with >5% absolute cover in the tree canopy. Stands occur along streams, springs, and valleys with a subsurface water supply, and may be mapped to small clumps less than 1 acre. *P. fremontii* occurs with *Salix, Forestiera, Baccharis,* etc. Stands co-dominated by tree willows such as *Salix gooddingii* or *S. laevigata* will key here. *P. fremontii* usually >5%, *Platanus*, *Salix laevigata*, each usually <5%; *S. gooddingii* may be co-dominant, shrubby *Salix lasiolepis*, *S. exigua*, or *Baccharis* spp. may be present with low to high cover in the understory…

1411 = *Populus fremontii* (Fremont cottonwood forest) Alliance

15'. *Populus fremontii* is not dominant or co-dominant...

16. *Salix laevigata* is the sole dominant in the overstory layer with at least 10% cover. Arroyo willow (*Salix lasiolepis)* may occur as a sub- or co-dominant in the shrub or low tree layer. If present, *S. lasiolepis <S. laevigata* and *Platanus racemosa, Populus* spp*.,* and *S. gooddingii* are all trace. Usually small stands associated with isolated springs and seeps, may be associated with *P. fremontii* or shrubby riparian stands of *Forestiera, S. exigua,* etc...

1412 = *Salix laevigata* (Red willow thickets) Alliance

16'. *Salix laevigata* is not dominant...

18. *Salix gooddingii* is the strongly dominant tree, while other tall woody shrubs may be sub-dominant. If present, *Platanus racemosa* and *Populus* spp. are both trace. Most stands are associated with the Mojave River or are in permanently wet areas in the Antelope Valley. Often adjacent to *P. fremontii stands...*

1413 = *Salix gooddingii* (Black willow thickets) Alliance (not mapped and not inventoried in study area)

17'. *Salix gooddingii* is not dominant...

18. *Platanus* racemosa is characteristic of the riparian tree canopy. If present, *Populus* spp. <*P*. *racemosa*. Along major stream courses, often associated with other stands of trees or shrubs within this macrogroup. Individuals of *P. racemosa* occur as far north as Victorville in the Mojave, but actual stands are limited to within a few miles of the edge of the ecoregion as at Rock Creek, Little Rock Creek, and several drainages emerging from the Tehachapi Mountains. Stands are common in the Cajon Pass area...
1414 = *Platanus racemosa* (California sycamore woodlands) Alliance

17'. Either *Alnus rhombifolia* or *Washingtonia filifera* dominant…

19. Stands characterized by even distribution of the California Fan Palm (*Washingtonia filifera*), associated with springs and moist canyon bottoms in a few places. Other riparian tree species (*Populus fremontii, Salix laevigata,* or *Prosopis glandulosa*) may be associated with them and may be co-dominant. Stands in the mapping area are mostly introduced in the recent past with the likely exception of Twentynine Palms Oasis and the Fortynine Palms Canyon area…
1415 = *Washingtonia filifera* (California fan palm oasis) Alliance (not mapped and not inventoried in study area)

19'. *Alnus rhombifolia* is present and evenly distributed in the riparian tree layer. If *Platanus* is present it is <1% cover and not evenly distributed; *Platanus* >1% keys to *Platanus* alliance. Occurs at extreme edge of study area near Valyermo and possibly other creeks that emerge from the Transverse Ranges…
1500 = Western Cordilleran Montane-Boreal Riparian Scrub and Forest MG034 (now called M034 Rocky Mountain & Great Basin Flooded & Swamp Forest)
1510 = Vancouverian riparian deciduous forest Group
1511 = *Alnus rhombifolia* (White alder groves) Forest Alliance

14'. Stands are dominated or characterized by native or non-native riparian shrubs. None of the above (couplet 15) tree species are present at significant cover or dispersion…

20. Native species of *Baccharis* spp*., Sambucus, Forestiera*, *Salix exigua* or *S. lasiolepis* are dominant or co-dominant*. Populus fremontii* and other *Salix* species may intermix at low cover and uneven distribution and tree willows or other riparian trees are <10% cover in the stand and/or are not evenly distributed…
1420 = Southwestern North American riparian/wash scrub Group

21. A *Baccharis* species is characteristic of the overstory shrub layer (three choices below)…

Baccharis emoryi usually covers >3% of a single stand and exceeds any other shrub in cover. Shrubs are like big *B. sergiloides* and tend to occur in lower elevation ditches or washes, not in granitic mountains near springs (where *B. sergiloides* is usually found). Mappable stands are rare in our area and only a few stands were detected in the field. This species occurs more commonly in the Colorado River Valley north of Blythe…
1421 = *Baccharis emoryi* (Emory's baccharis thickets) Provisional Alliance (not mapped and not inventoried in study area)

Shrublands characterized by the dominance of *Baccharis salicifolia,* usually with >50% relative cover in shrub layer. An emergent and sparse tree layer of willows or other species may also be present. Found in upper arroyos on alluvial fans

emerging from San Gabriel or San Bernardino Mountains, along the Mojave River at least to Victorville, where it is adjacent to *Populus fremontii, Salix gooddingii, Tamarix,* or other riparian stands…
1422 = *Baccharis salicifolia* (Mulefat thickets) Alliance

Baccharis sergiloides dominant and characteristic; stands are usually small and associated with rocky granitic arroyos and narrow bouldery drainages adjacent to springs and seeps. Usually in desert mountains or ephemeral creeks in foothills of the Tehachapi, Liebre, or Transverse Ranges…
1423 = *Baccharis sergiloides* (Broom baccharis thickets) Alliance

21'. A *Salix, Forestiera, or Sambucus* species is dominant in the shrub layer…

22. A *Salix* is dominant (two choices below)…

Salix lasiolepis relative cover is over 50% and no other willows are dominant, though *Salix exigua* may be co-dominant. Considered a shrub even though it may be taller than 5 m, it may be accompanied by *Baccharis salicifolia* or other riparian shrubs. Small stands occur adjacent to freshwater streams and drainages in the western portion of the mapping area, usually below MMU except along Mojave River in Victorville or at the margin of the desert ecoregion as near Cajon Pass. If present, *S. laevigata <S. lasiolepis and P. racemosa, Populus spp.,* and *S. gooddingii* are all trace…
1427 = *Salix lasiolepis* (Arroyo willow thickets)

Salix exigua is characteristically present as a dominant or co-dominant shrub, usually with >5% absolute cover and >50% relative cover in shrub layer. It forms an open to continuous canopy along riparian corridors. It often forms narrow strips along major creeks and rivers and along ditches and reservoir edges. Other willow species may be present as sub-dominants with low cover, and *Baccharis salicifolia* may occasionally be co-dominant…
1424 = *Salix exigua* (Sandbar willow thickets) Alliance

22'. *Forestiera* or *Sambucus* are dominant (two choices below)…

Forestiera pubescens is the dominant shrub species in the canopy, usually occurring locally around permanent water or subsurface moisture. Stands occur in the western part of the mapping area adjacent to alkaline flats or on steeper slopes and along ravines in Sierra Pelona. Stands also occur in mostly montane foothill areas around isolated springs or in bottoms of narrow canyons in the foothills of the Sierra Nevada, Ord Mountains, and the El Paso Mountains. Compared to the *Salix exigua* and *Populus fremontii* alliance*, Forestiera pubescens* Intermittently Flooded Shrubland appears to prefer slightly drier conditions as upslope from flowing water. Stands are usually dense with a sparse understory...
1425 = *Forestiera pubescens* (Desert olive patches) Alliance

Sambucus nigra is dominant in the overstory (although other shorter shrubs such as *Artemisia tridentata* ssp. *tridentata* and *Eriodictyon* may be equal or somewhat higher in cover). Although considered a shrub, elderberry usually takes the form of a small tree, which forms open, well-spaced stands with a shorter shrub and herb understory. Mappable stands occur only in the margins of the study area including moist bottomlands adjacent to Mojave River near Hesperia, south to Mormon Rocks and Cajon Pass…
1426 = *Sambucus nigra* (Blue elderberry stands) Alliance

20'. Stands are dominated by non-native *Tamarix (chinensis, ramosissima*, etc.) or the tall reed *Arundo donax*.
1430 = Southwestern North American introduced riparian scrub Group (two choices below)…

25. *Arundo donax* dominates as clonal clumps in moist areas. A few small stands occur in moist areas along ditches or occasionally in lines along property boundaries or planted as windbreaks. It may not occur in study area as true semi-natural stands. The characteristic signature of *Arundo* should be sufficient to pull out small planted stands (exotic plantings as part of development polygons), but the semi natural 1431 mapping unit is reserved for areas that are not planted or are at least expanding)…
1431 = *Arundo donax* (Giant reed breaks) Semi-natural Stands

25'. Vegetation strongly dominated (usually >60% relative cover) by tall shrubby invasive *Tamarix* spp. (either *T. ramosissima, T. chinensis*, or other similar species, not including the less invasive, taller *T. aphylla*) over other native tall shrubs and/or low trees. *T. aphylla* (Athyl) trees are usually not invasive and remain in their originally planted arrangement (hortomorphic)…
1432 = *Tamarix* spp. (Tamarisk thickets) Semi-natural Stands

13'. Vegetation characterized by trees not of wetland or moist low lying areas, although they may grow in washes, arroyos, playas and other intermittently flooded situations…

24. Forest and woodlands characterized by broad-leaved evergreen trees, sometimes with dwarfed stems and small, sclerophyllous leaves (in Mediterranean climates); or various combinations of broad-leaved deciduous, broad-leaved evergreen and needle-leaved evergreen conifer trees. Canopy may range from woodland or forest structure. Winters are mild (mostly frost-free), and may be the rainiest season, springs are temperate humid, summers are hot-dry, and autumn is often dry. Characteristic tree distributions are centered in Mediterranean California climate, may be broadleaf evergreen or deciduous or may be coniferous species. Not characteristic of cooler parts of California (mountain or northern affinities)…
1.B.1. Warm Temperate Forest Formation (F018)
1100 = California Forest and Woodland Macrogroup MG009

25. Broadleaf evergreen or winter deciduous trees of California Mediterranean climate zone. Includes mostly oak trees of the genus *Quercus* in our area, but also includes small extralimital stands of *Aesculus californica* and *Juglans californica…*
1110 = Californian broadleaf forest and woodland Group

26. One or more *Quercus* species are the primary overstory canopy tree, or oaks share dominance with conifers (five choices below)…

Quercus douglasii is usually dominant to co-dominant locally in the tree layer. If mixed with *Quercus lobata, Pinus sabiniana, Juniperus californica*, or *Quercus chrysolepis*, it must have >60% relative cover. Generally only at the base of Liebre Mountains and in the extreme westernmost Tehachapi Mountains near Gorman. Stands are mixed with *Juniperus californica* and *Quercus john-tuckeri* along with emergent *Pinus sabiniana* and a mixture of transmontane and cismontane shrubs and herbs. Stands mostly occur in sheltered locations such as bases of slopes or on north-facing exposures…
1111 = *Quercus douglasii* (Blue oak woodland) Alliance

Quercus lobata is dominant to co-dominant. May mix with *Quercus douglasii*, *Q. chrysolepis*, or *Pinus sabiniana*, but must be least 30% relative cover in canopy. Generally only at the base of the Liebre Mountains and in the extreme

westernmost Tehachapi Mountains near Gorman. Stands are usually in deeper, more mesic soils than *Q. douglasii* stands and are scattered in concave to sheltered (flat) slope positions. Best stands occur in Liebre Mountains between Gorman and Lone Pine Canyon Road…
1112 = *Quercus lobata* (Valley oak woodland) Alliance

Quercus chrysolepis is dominant to co-dominant in the tree overstory. Only along the Transverse Ranges, on generally steep north-facing or concave exposures. If co-occurring with other oaks (e.g., *Q. lobata or Q. wislizeni*), *Q. chrysolepis* must have at least 30% cover. If co-occurring with *Pinus monophylla, Q. chrysolepis* must be >60% relative cover. If *Pseudotsuga macrocarpa* is co-dominant to dominant, then key to *P. macrocarpa* alliance.
1113 = *Quercus chrysolepis* (Canyon live oak forest) Alliance

Quercus wislizeni is dominant or co-dominant with >30% relative cover in the tree overstory. *Q. douglasii* and *Quercus chrysolepis*, if present, occur at low cover (generally <30% relative canopy cover). Stands are limited to the north-facing base of the Liebre and San Gabriel Mountains as far east as Cajon Pass and Silverwood Lake**.** Some in the Silverwood Lake stands are in low valleys or on terraces adjacent to true riparian woodlands. Many have been recently burned and are scrubby. No shrub *Q. wislizeni* ssp. *frutescens* alliance (which would key in the pre-montane chaparral group) has been identified in the study area…
1114 = *Quercus wislizeni* (Interior live oak woodland) Alliance

Quercus agrifolia is dominant to co-dominant in the tree overstory, sometimes with *Quercus douglasii*. May be very rare in the map area, only along the base of the Tehachapi Mountains near the far western tip of the mapping area, on lower slopes above intermittent streams with *Platanus racemosa* Alliance stands. One inventoried stand with *Quercus douglasii* had insufficient relative tree cover for the *Q. agrifolia* Alliance (< 30%) and keyed to the *Quercus douglasii* Alliance. Another nearby stand with scattered *Q. agrifolia* as the major tree component may be tentatively keyed to *Q. agrifolia*. Other stands exist in Transverse Range near, but outside of mapping area (e.g., south of Cajon Pass).
1117 = *Quercus agrifolia* (Coast live oak forest) Alliance

26'. Broad-leaf trees other than oaks are dominant or co-dominant (two choices below)…

Juglans californica provides an open to intermittent tree overstory canopy (in some cases it may be a large shrub). Stands are limited in the coastal drainages south of Cajon Pass and are associated with seeps and springs. Shrubs of chaparral *(Ceanothus* sp., *Heteromeles arbutifolia*, etc.) may occur in the understory…
1115 = *Juglans* californica (California walnut groves) Alliance (not mapped and not inventoried in study area)

Aesculus californica is dominant (>60% relative cover) as a tree or tall shrub in the overstory. If buckeye is co-dominant with an oak species, see the *Quercus douglasii* and *Quercus wislizeni* Alliances. Only in the extreme western portion of the study area on north facing or concave slopes of the Liebre Mountains, adjacent to stands of chaparral or *Q. wislizeni*…
1116 = *Aesculus californica* (California buckeye groves) Alliance

25'. Canopy dominated by conifers, locally, either short shrubby trees of *Juniperus californica* or by taller *Pinus sabiniana*. Stands with other xeromorphic or mesomorphic

trees may occur (*Yucca brevifolia, Quercus lobata, Q. douglasii, Q. chrysolepis*), if so, different relative cover rules apply, see comments within key to alliances in this group.
1120 = Californian evergreen coniferous forest and woodland Group (two choices below)…

Pinus sabiniana is the dominant tree in the overstory (>60% relative cover), and generally has >10% absolute cover. Stands identifiable as the alliance occur largely over herbaceous or mixed shrub and herb understories. Stands are limited in extent, usually in proximity to *Quercus john-tuckeri* (shrub), *Quercus lobata* or *Quercus douglasii* stands. Most stands occur over grassy understory in northwest Liebre Mountains….
1121 = *Pinus sabiniana* (Foothill pine woodland) Alliance

Juniperus californica is evenly distributed and the dominant species in the tree or tall shrub layer. If *Yucca brevifolia* is present and evenly distributed, it has no more than 30% relative cover (or if *J. californica* >10% absolute cover, then *Y. brevifolia* has no more than 4 % absolute cover) in the tree or tall shrub layer. In other words, when *Yucca brevifolia* is present, *Juniperus* must have at least 3X its cover. Most *Juniperus* stands range from 3 to 15% absolute *J. californica* cover. When sparse (*e.g.*, <5%), the general rule is that *J. californica* is evenly distributed and, if present with large shrubs such as *Purshia tridentata, Adenostoma fasciculata, Quercus john-tuckeri,* or *Arctostaphylos glauca*, they must have strong dominance to fall within their own alliances (*e.g.*, *J. californica* is 4% and *Quercus john-tuckeri* is <2% goes to *Juniperus*). This is because although *J. californica* is considered a "tree" it is ecologically a large shrub…
1122 = *Juniperus californica* (California juniper woodland) Alliance

24'. Stands are pure or mixed broad-leaved deciduous or needle-leaved evergreen tree growth forms, with a seasonal green understory of herbs. Winters are cool and summers may receive some montane thunderstorms. The tall-shrub layer is variable. Stands occur in higher elevation areas at the edge of the desert in the Transverse Ranges or Sierra Nevada, or in highest desert mountains. Snow may be on the ground between <1 to 6 months of the year…
1.B.2. Cool Temperate Forest Formation (F008)

27. Stands characterized by *Pseudotsuga macrocarpa* present and evenly distributed in canopy, usually with *Quercus chrysolepis* co-dominant, which may be up to 3 times the cover (*e.g.*, *Q. chrysolepis* 30%, *Pseudotsuga macrocarpa* 10%). Restricted to sheltered sites (sheltered from canopy fire and relatively steep and shady lower canyons and slopes) in Liebre and San Gabriel Mountains …
1200 = Californian-Vancouverian Montane and Foothill Forest Macrogroup MG023 (now called M023 Southern Vancouverian Montane & Foothill Forest)
1210 = Californian montane conifer forest Group
1211 = *Pseudotsuga macrocarpa* (Bigcone Douglas-fir) Alliance

27'. *Pinus monophylla* >1% absolute cover and evenly distributed throughout the stand. Stand may have equal or higher cover of *Juniperus californica, Yucca brevifolia* and/or shrubs such as *Quercus john-tuckeri.* Locally only represented by *Pinus monophylla* alliance. Difficulty in stand identification exists at ecoregional boundaries in stands with co-dominance of *Juniperus californica* or with scrub oaks such as *Quercus john-tuckeri* or other tall chaparral species such as *Fremontodendron californica*, *Cercocarpus montanus, Arctostaphylos glandulosa,* etc. If these species are present and <10% absolute cover, *Pinus monophylla* must be >1% absolute cover and evenly distributed in the stand (usually it is at least 5% cover and evenly distributed). If chaparral species are >25% absolute cover throughout the stand, *P. monophylla* must be >10% absolute cover (e.g., scattered low cover *P. monophylla* is overruled by dense chaparral stands). If *Yucca brevifolia* is present and >1% cover, the stand must have >3x as much *Pinus*

monophylla to be *Pinus (Yucca brevifolia* takes precedence when co-dominant). If *Juniperus californica* is present, *Juniperus* must have >3x as much absolute cover as *Pinus monophylla* (which takes precedence when co-dominant)…
1300 = Intermountain Basins Pinyon-Juniper Woodland Macrogroup MG026 (now called: M026 Intermountain Singleleaf Pinyon - Western Juniper Woodland)
1310 = Western Great Basin montane conifer woodland Group
1311 = *Pinus monophylla* (Singleleaf pinyon woodland) Alliance

12'. Vegetation dominated by shrubs or herbs; trees if present, generally <10% absolute cover, or if greater cover, then characterized by trees with xeromorphic features such as succulence, spines, or drought-deciduousness…

28. Vegetation dominated by mesomorphic grasses and shrubs, with or without scattered trees (and trees typically <10% cover), ranging from temperate coastal and inland lowland and montane grasslands and shrublands, to bogs, fens, and marshes, with a strongly seasonal climate, with at least some frost to extended cold seasons. Occasional desert border stands have a mixing of mesomorphic and xeromorphic (class 2000, mixing with desert classes 4000 and 5000) species. The woody species of the predominant class (*e.g.*, chaparral shrubs with small proportion of emergent xerophyll Joshua Trees) would prevail in the key…
2000 = MESOMORPHIC SHRUB AND HERB CLASS (2 Temperate & Boreal Shrubland & Grassland)

29. Vegetation defined by plant growth strategies driven by a Mediterranean climate, characterized by dry summers and mild, humid, sometimes rainy winters. Sclerophyll-leaved shrub growth forms prevail, but drought-deciduous forms may also occur. Size and coverage of the shrubs range from arborescent (2m to 5m tall) with a closed canopy, to <1m and open. Mediterranean grassland and meadow are included in this formation. In California, they are separated from Mediterranean scrub at the formation level. This formation occurs primarily in the western Mojave adjacent to the Transverse Ranges and the southern Sierra Nevada and Tehachapi Mountains where enough winter moisture affords persisting stands of non-desert chaparral, coastal scrub, and grasslands…
2.B Mediterranean Scrub & Grassland Subclass

30. Vegetation characterized by shrubs averaging ≥10% in even distribution over the stand and herbaceous species not predominant.
2.B.1. Mediterranean Scrub & Grassland Formation (F038)

31. Shrubby sclerophylls (formation typically known as chaparral) dominant in the overstory; indicator genera include *Arctostaphylos, Adenostoma, Ceanothus, Fremontodendron, Quercus* (scrub oak species), etc. Note that at the margins of the desert, chaparral intermingles with desert scrub types where unusual stand composition can occur. Where diagnostic chaparral shrub species are present and make up >50% relative cover of woody species in a stand and are evenly distributed, the stand would key to a member of this group…
2100 = California Chaparral Macrogroup MG043

32. Sclerophyll shrublands characterized by the dominance of one or more of the following species: *Adenostoma fasciculatum, Arctostaphylos glauca, Ceanothus crassifolius*, or *Fremontodendron*. Stands may have co-dominance of drought-deciduous *Salvia mellifera*. This shrubland group includes chaparral typically located inland from maritime chaparral from sea level up to 2000m (6400ft) elevation. It ranges from inland portions of northern Baja California, Mexico, southern, central and northern California through the northern end of the Great Valley and north into Oregon. Most stands occur on well-drained soils on exposures that are in full sun much of the growing season including upper

slopes, spur ridges, and convexities. This group is made up of a mixture of obligate seeders, facultative seeders, and resprouters…
2110 = Californian xeric chaparral Group

33. *Adenostoma fasciculatum* is the sole dominant or is co-dominant with *Salvia mellifera, Eriogonum fasciculatum* or a species of *Eriodictyon.* If *Quercus berberidifolia* or *Cercocarpus montanus* co-dominates, see leads 35 and 35', respectively (two choices below)…

    A*denostoma fasciculatum* occurs as a dominant, or as a co-dominant with *Eriogonum fasciculatum* or other shrubs such as *Eriodictyon crassifolium* or *E. trichocalyx*. If co-dominant with *Arctostaphylos glauca,* then key to *A. glauca* alliance. Occurs along the margins of the Transverse Range and the Tehachapi Mountains (probably mostly out of our area in the Tehachapis). Found on convex slopes above stands of *Quercus john-tuckeri, Artemisia tridentata, Salazaria mexicana,* and *Eriogonum fasciculatum* on slopes ramping up to Cajon Pass area…
    2112 = *Adenostoma fasciculatum* (Chamise) Alliance

    Salvia mellifera shares dominance with *Adenostoma fasciculatum* in the shrub canopy, with *A. fasciculatum* sometimes having twice as much cover as *S. mellifera*. Only a few stands occur in coastal drainages on steep south- or west- facing. Mostly sandstone slopes south of Cajon Pass, south and east of Mormon Rocks...
    2115 = *Adenostoma fasciculatum – Salvia mellifera* (Chamise-black sage chaparral) Alliance

33'. Species other than *Adenostoma fasciculatum* are dominant or co-dominant (three choices below)…

    Arctostaphylos glauca is the dominant or co-dominant overstory shrub (locally especially with *Adenostoma fasciculatum*); conifers (*Pinus, Juniperus*) absent or in very low cover. Occurs only on the edges of the study area in the Tehachapi Mountains or Transverse Ranges, usually adjacent to other chaparral stands such as A*denostoma, Fremontodendron,* or *Quercus john-tuckeri.* May occur adjacent to *Juniperus* or to *Pinus monophylla* stands*.* Most stands are small, sometimes on steep slopes mixed with scattered *Yucca brevifolia.* Largest stands in map area are near Cajon Pass and mixed with *A. fasciculatum…*
    2111 = *Arctostaphylos glauca* (Bigberry manzanita chaparral) Alliance

    Ceanothus crassifolius usually occurs as a dominant or as a co-dominant with other chaparral shrubs (*e.g.*, *Adenostoma fasciculatum, Heteromeles arbutifolia* and *Cercocarpus montanus*). Only occurs in the southern portion of the mapping area, southwest of Cajon Pass, which drains to the Santa Ana River and Pacific Ocean…
    2113 = *Ceanothus crassifolius* (Hoary leaf ceanothus chaparral) Alliance

    Stands dominated by the tall shrub *Fremontodendron californicum,* with a mixture of desert chaparral and shorter shrubs including *Purshia tridentata, Hesperoyucca whipplei, Eriodictyon trichocalyx, Eriogonum fasciculatum, Cercocarpus montanus, Ceanothus leucodermis, Ericameria linearifolia, Salvia dorrii Artemisia tridentata* ssp. *tridentata,*

and scattered emergent *Yucca brevifolia.* Occurs on coarse alluvium including edges of arroyos and washes of upper valleys or lower steep slopes of mountains. Often adjacent to *Quercus john-tuckeri, Adenostoma fasciculatum, Pinus monophylla* and *Yucca brevifolia stands,* or recent burns with *Encelia actoni* and *Eriogonum fasciculatum s*tands…
2114 = *Fremontodendron californicum* (flannelbush scrub) Alliance

32'. Chaparral stands of either cooler (winters with regular frost and snow) or moister (north-facing slopes and concavities) environments than previous group. Other shrub species predominant than those listed in couplet 32…

34. Stands are either co-dominated or dominated by *Arctostaphylos glandulosa* or *Ceanothus leucodermis*. This group consists of sclerophyllous shrublands that are more frost-tolerant and found at higher, cooler and generally more mesic sites than the California Xeric Chaparral Group (G257) or the California Mesic Sclerophyll Scrub Group (G261). They are particularly well-developed in central and southern California mountains between 1000 and 2000m, and tend to be composed of both shrubs that can resprout but also have obligate seeding indicator shrubs…
2120 = Californian pre-montane chaparral Group (two choices below)

Arctostaphylos glandulosa usually occurs as a dominant or co-dominant in the shrub overstory. Stands are found on north-facing slopes, outcrops, and ridges on shallow soils, only on the desert-facing slopes of the San Gabriel Mountains as near Pine Creek and south of Mormon Rocks. Common only on open ridges and convex slopes surrounded by other chaparral stands (e.g., *Adenostoma fasciculatum* or *Quercus berberidifolia* south of Mormon Rocks) or near Hwy 2 and Desert-Front Road. Difficult to tell from *A. glauca* in some cases without burl inspection…
2121 = *Arctostaphylos glandulosa* (Eastwood manzanita) Alliance

Ceanothus leucodermis characterizes the shrub canopy as a dominant or co-dominant. No consistent canopy tree overstory (top-killed stems of short resprouts of *Quercus wislizeni* may be present, though). Stands are found primarily on north-facing slopes only in recently burned areas of the Liebre Mountains. A common post-fire regeneration type following a 2000 fire in *Quercus wislizeni* and some resprouting chaparral stands. Occurs adjacent to *Quercus lobata* stands as well…
2122 = *Ceanothus leucodermis* (Chaparral whitethorn) Alliance

34'. This shrubland group occurs in mesic site conditions such as north-facing slopes, concavities and toeslopes with well-drained soils throughout Mediterranean California, mostly inland from the coastal fog belt. It occurs most often on north-facing slopes up to 1500m (4550ft) in elevation and up to 1830m (6000ft) in southern California. This group tends to be dominated by a variety of mixed or single-species, evergreen, sclerophyllous shrubs that resprout from lignotubers following fire…
2130 = Californian mesic chaparral Group

35. Stands characterized by *Quercus berberidifolia* with or without co-dominance of *Adenostoma fasciculatum* (two choices below)…

Quercus berberidifolia usually occurs as a dominant or, if it co-dominates, it is not with *Adenostoma fasciculatum* or *Cercocarpus*

montanus. It is only in the southern part of the mapping area, southwest of Cajon Pass, and probably does not occur in the Liebre Mountains. Individuals of *Q. berberidifolia* occur within stands of *Q. john-tuckeri* near Cajon Pass and stands are difficult to discriminate from *Q. john-tuckeri* alliance. When in doubt go with surrounding associated species; if desert mix then *Q. john-tuckeri*, if mostly other California chaparral species, then *Quercus berberidifolia* …
2132 = *Quercus berberidifolia* (Scrub oak chaparral) Alliance

Quercus berberidifolia co-dominates with *Adenostoma fasciculatum* (*Adenostoma fasciculatum* and *Quercus berberidifolia* each having greater than 15% relative cover in the shrub layer). Other shrubs in the stands have significantly less cover. Only in Cajon Pass and Pine Creek area…
2133 = *Quercus berberidifolia – Adenostoma fasciculatum* (Scrub oak-chamise chaparral) Alliance

35'. Stands characterized by *Cercocarpus montanus* or *Prunus ilicifolia* as dominants or co-dominants (two choices below)…

Cercocarpus montanus >30% relative cover and usually with the highest cover. *Adenostoma fasciculatum, Arctostaphylos glauca,* or *Eriogonum fasciculatum* may have similar cover. Only in the northwest portion of the Liebre Mountains in the extreme west of mapping area, or on north slopes of San Gabriel Mountains or Cajon Pass area. Usually associated with the *Quercus john-tuckeri*, *Arctostaphylos glauca, Eriogonum fasciculatum* or *Adenostoma fasciculatum* alliances. May have emergent *Pinus sabiniana* or *Pinus monophylla...*
2131 = *Cercocarpus montanus* (Birchleaf mountain mahogany) Alliance

Stands dominated or co-dominated by *Prunus ilicifolia*. *Heteromeles arbutifolia* or a species of *Eriodictyon* may be co-dominant. If *Quercus john-tuckeri* co-dominates, the stand keys to *Q. john-tuckeri* alliance. Rare in the study area; usually on either steep south- or east-facing slopes near Canon Pass…
2134 = *Prunus ilicifolia* (Holly leaf cherry chaparral) Alliance

31'. Stands dominated by drought-deciduous shrubs, though at times can have characteristic (constant but not dominant) resprouting, deep-rooted sclerophyllous shrubs. Stands include mixed coastal shrublands from central California south into Baja, Mexico. Stands generally occur below 1500m (5000ft) elevation and may extend inland from the maritime zone in hotter, drier conditions. Soils vary from coarse gravels to clays but typically only support plant-available moisture with winter and spring rains. Most predominant shrubs include *Artemisia californica, Salvia mellifera, Salvia apiana, Salvia leucophylla, Encelia californica, Eriogonum fasciculatum, Eriogonum cinereum*, and *Opuntia littoralis*. On recently disturbed sites, such as after fire, *Mimulus aurantiacus, Lotus scoparius*, and *Lupinus albifrons* can be dominant. Note: *Eriogonum fasciculatum* alliance stands occur in different expressions throughout the study area, including coastal scrub stands on the margins of the Transverse Ranges and the Tehachapi Mountains, often adjacent to chaparral, and desert stands where often mixed with *Ephedra nevadensis, Yucca* spp*., Viguiera parishii, Simmondsia chinensis, Grayia spinosa,* and other desert shrubs. At this point without detailed analysis it is unwise to further segregate desert and non-desert *Eriogonum fasciculatum* alliance stands, so *E. fasciculatum* alliances will be found in

this macrogroup, as well as in the Inter-Mountain Dry Shrubland and Grassland Macrogroup MG098. Dominance in membership rules in the desert macrogroup will align with desert scrub cover and thus will be only ≥2% cover as long as no other shrub exceeds *E. fasciculatum* in cover…
2200 = California Coastal Scrub Macrogroup MG044

36. Stands usually open and/or display recent evidence of fire or other disturbance. Stands are dominated or co-dominated by the following species: *Gutierrezia californica, Lotus scoparius, Lupinus albifrons, Ericameria linearifolia,* or a species of *Eriodictyon, Malacothamnus fasciculatus, Eriogonum elongatum, Eriogonum nudum*, *Corethrogyne filaginifolia, Dendromecon rigida…*
2210 = Central and south coastal California seral scrub Group (nine choices below)…

The short shrub, *Gutierrezia californica* dominates an open shrub canopy, and other shrubs may occur at low cover. The herb layer is usually well-developed, including natives such as *Poa secunda* and non-natives such as *Bromus* and *Erodium* species. Appears in western Antelope Valley associated with grasslands…
2211 = *Gutierrezia californica* (California match weed patches) Provisional Alliance (not mapped and not inventoried in study area)

Successional shrublands occurring in chaparral or coastal sage scrub in which short-lived subshrubs or shrubs of *Lotus scoparius* dominate following disturbance, particularly fire. The shrub canopy is sometimes over a higher cover of annual or perennial herbs such as *Bromus* spp., *Corethrogyne filaginifolia, Nassella, Erodium* spp., *Avena* spp., etc. Stands have been observed only on the portion of study area that drains to the Pacific Ocean in the vicinity of Cajon Pass…
2212 = *Lotus scoparius* (Deer weed scrub) Alliance (not mapped and not inventoried in study area)

Lupinus albifrons dominates in the shrub canopy and grows on slopes that may be disturbed, steep, and unstable. A variety of coastal sage shrubs may be present, including *Ericameria linearifolia, Eriogonum fasciculatum* and others…
2213 = *Lupinus albifrons* (Silver bush lupine scrub) Alliance (not mapped and not inventoried in study area)

Ericameria linearifolia is dominant to co-dominant in the shrub canopy with *Isomeris arborea* and/or *Gutierrezia californica, Eriophyllum confertiflorum, Eriogonum fasciculatum* and others. The herb layer can be well-developed, and *Poa secunda* is characteristically present…
2214 = *Ericameria linearifolia - Isomeris arborea* (Narrowleaf goldenbush-bladderpod scrub) Alliance

An *Eriodictyon* species dominates and *Eriogonum fasciculatum* often intermixes. Locally stands are dominated by *E. trichocalyx* or *E. crassifolium.* Typically, stands are *E. crassifolium* on the north side of the Liebre Mountains and *E. trichocalyx* on the north side of the San Gabriel and San Bernardino Mountains and in the Cajon Pass region...
2215 = *Eriodictyon (crassifolium, trichocalyx*) (Thick leaf and hairy yerba santa scrub) Provisional Alliance

Corethrogyne filaginifolia characterizes stands, usually having the highest cover in recently burned margins of chaparral or coastal sage scrub in the

foothill regions of the Western Mojave Desert. Regenerating shrubs may intermix with lower cover than *C. filaginifolia*. Small sub-MMU stands occur in the vicinity of Cajon Pass and the northern Liebre Mountains foothills…
2218 = *Corethrogyne filaginifolia* (Common sandaster scrub) Alliance

Malacothamnus fasciculata dominates recently burned chaparral. No mappable stands have been inventoried, but small patches occur in the vicinity of the Liebre Mountains and Cajon Pass…
2216 = *Malacothamnus fasciculatus* (Bush mallow scrub) Alliance (not mapped and not inventoried in study area)

Eriogonum elongatum or *E. nudum* occur within herbaceous stands often co-dominated by native and non-native grasses and annual forbs. These mid-size perennial herbs are sometimes abundant colonizers of recent burns or areas released from repeated regular grazing in the foothill regions of the west Mojave Desert…
2217 = *Eriogonum* (*elongatum, nudum*) (Longstem buckwheat) Provisional Alliance (not mapped and not inventoried in study area)

Dendromecon rigida, a short-lived shrub characteristic of recent post fire chaparral stands at the border of the study area, is dominant. Only one stand is mapped near Cajon Pass. Post fire stands are to be expected in similar areas of chaparral. Usually within a few years, stands are replaced by longer lived shrubs such as *Adenostoma fasciculatum* or *Quercus berberidifolia*…
5216 = *Dendromecon rigida* (Bush poppy scrub) Alliance
(within 5200 = Cool Semi-Desert Wash and Disturbance Scrub Macrogroup, MG095)

36'. Stands are characterized by the presence of *Eriogonum fasciculatum, Salvia mellifera*, or *Eriogonum wrightii* without significant cover of the previous group of seral scrubs…
2220 = Central and South Coastal Californian coastal sage scrub Group (three choices below)...

Eriogonum fasciculatum typically ≥2% absolute cover or >50% relative cover in the shrub canopy, but read full description for exceptions. Most pure stands occur along the east face of the Tehachapi and Scodie Mountains. These stands and those in the Cajon Pass area surrounded by chaparral tend to have substantially higher shrub cover and usually do not co-dominate with many species. Instead they are often single dominant stands. In the desert hills and mountains >1000m (3000ft) elevation, *Eriogonum fasciculatum* co-occurs with many other semi-desert shrubs; if *Encelia actoni, Ericameria teretifolia, Purshia tridentata, or Ericameria linearifolia* are equal or higher cover, stands key to those alliances. *Hyptis emoryi* or *Salvia dorrii* may be higher than *E. fasciculatum* and still be in the *Eriogonum fasciculatum* Alliance (Thomas et al. 2004). Mixed stands with *Ephedra nevadensis, Ambrosia salsola, Ericameria cooperi, Grayia spinosa,* and other mid elevation shrubs only require *Eriogonum fasciculatum* to be higher cover and/or more evenly distributed than any of the other shrubs…
2221 = *Eriogonum fasciculatum* (California buckwheat scrub) Alliance

Eriogonum wrightii is dominant. Associated with *Eriogonum fasciculatum, Ericameria cooperi,* and *Prunus fasciculata* stands in the vicinity of Hesperia and Cajon Pass. May have emergent *Yucca brevifolia* or *Juniperus californica*…
2222 = *Eriogonum wrightii* (Wright's buckwheat patches)

Salvia mellifera usually >60% or combined with a coastal scrub species >30% relative cover in the shrub canopy (Klein and Evens 2005, Keeler-Wolf and Evens 2006). Only occurs southwest of Palmdale on Sierra Pelona and Signal Ridge adjacent to the California Aqueduct…
2223 = *Salvia mellifera* (Black sage scrub) Alliance (not mapped and not inventoried in study area)

30'. Vegetation characterized by grasses and herbs adapted to Mediterranean climates. Shrubs, if present, not >10% and/or not evenly distributed in the stand…
2.B.2 Mediterranean Grassland & Forb Meadow Formation
D021 California Grassland & Meadow Division
2300 = California Annual and Perennial Grassland Macrogroup MG045
Note: stands that are assumed to contain native species especially without wildflower color signature are placed into this mapping unit…
2305 = California annual and perennial grassland Mapping Unit (Native component)

37. Stands dominated or characterized by mostly annual grasses and forbs. Native herbs are characteristic and evenly distributed across the herbaceous layer, though non-native forbs and grasses may be dominant. Cover and composition vary year to year, but indicators usually present in sufficient amounts to differentiate from non-native stands. Diagnostic species include *Amsinckia* spp., *Eschscholzia* spp., *Lasthenia* spp., *Plantago erecta* and *Vulpia microstachys*…
2310 = California annual forb/grass vegetation Group

38. *Eschscholzia californica* is seasonally dominant on upland slopes or flats with well-drained sandy to loamy soils. *Amsinckia, Avena, Bromus, Castilleja exserta, Erodium cicutarium, Lupinus bicolor, Lupinus microcarpus, Uropappus lindleyi* and a variety of other native and non-native forbs and grasses may be present. Known from famous wildflower fields in Antelope Valley on non-alkaline soils from west of Lancaster and Palmdale to Gorman; associated with *Poa secunda, Achnatherum speciosum, Gutierrezia, Eriogonum fasciculatum, Ericameria linearifolia,* and *E. nauseosa* alliance stands. Tolerates regular spring grazing and some agricultural tilling history…
2311 = *Eschscholzia (californica)* (California poppy fields) Alliance

38'. *Eschscholzia californica* is not conspicuous in the spring flowering season. Other wildflower species characteristic of Mediterranean California are present…

39. *Amsinckia menziesii, A. tessellata, A. vernicosa,* and/or *Phacelia* spp. are seasonally characteristic in the herbaceous layer with greater than or equal to 10% relative cover. Soils are often well-drained and loamy and may have high levels of bioturbation (*e.g.,* rodent burrows) and/or high levels of (past/current) grazing. Stands may also occur well into the central Mojave Desert in good rainfall years in recently disturbed (mostly burned) desert scrub…
2312 = *Amsinckia (menziesii, tessellata)* (Fiddleneck fields) Alliance

39'. Other species besides *Amsinckia* and *Phacelia* are characteristic and/or dominant in proper phenology (three choices below)…

Native annual species *Vulpia microstachys*, *Plantago erecta* and/or *Lasthenia californica* (or *L. gracilis)* are characteristically present in stands and usually at least 10% relative in cover to other herbs. Other native species such as *Castilleja exserta, Crassula connata, Lepidium nitidum, Lupinus,* and *Trifolium* species are often well-represented (and

sometimes co-dominant to dominant) as well as a variety of herbs. Soils may be clayey, wet to moist in spring and dry by summer. Stands occur in Antelope Valley west of Lancaster and Palmdale, but may occur in clearings in *Larrea tridentata* or related alliances all the way to the Granite and Sidewinder Mountains. Stands with an even distribution of *Larrea* or other desert shrubs >2% would key to the shrub type. Must have properly timed aerial imagery for detection…
2313 = *Lasthenia californica - Plantago erecta - Vulpia microstachys* (California goldfields - Dwarf plantain - Six-weeks fescue flower fields) Alliance

Monolopia lanceolata is seasonally dominant or co-dominant on fine-textured, moderate to steep slopes, or *Coreopsis calliopsidea* is the dominant annual herb. Less than 2% absolute shrub cover and/or shrubs not evenly distributed. Stands form bright golden-yellow seasonal patches on fine textured soils in the West Mojave (especially the area around Four Corners). [Note: *Coreopsis calliopsidea* is actually likely to be a better indicator of mud hills and clay beds (6113) in the Lithomorphic class than of California annual forb/grass vegetation Group (2310)]…
2314 = *Monolopia (lanceolata)-Coreopsis (calliopsidea)* (*Monolopia* and Tickseed) Alliance (not mapped and not inventoried in study area)

Plagiobothrys nothofulvus or other similar *Plagiobothrys* are dominant and characteristic in spring seasons with good rainfall. Probably does not form mappable stands in the study area; most stands with *Plagiobothrys* or other ecologically similar species (e.g., *Cryptantha* or *Pectocarya* sp.) are part of other alliances such as *Eschscholzia, Bromus-Schismus, Lasthenia*, etc...
2315 = *Plagiobothrys nothofulvus* (Popcorn flower fields) Alliance (not mapped and not inventoried in study area)

37'. Stands characterized by native perennial bunch grasses such as *Nassella pulchra* OR completely dominated by non-native annual grasses (*e.g.*, *Bromus rubens, Schismus* spp.) or forbs (*e.g.*, *Brassica* sp., *Salsola* sp.) with little or no native component…

40. Stands dominated or characterized by perennial native bunch grasses usually with a number of native and non-native annuals present…
2320 = California perennial grassland Group

2321 = *Nassella cernua* (Nodding needle grass grassland) Provisional Alliance
OR
2322 = *Nassella pulchra* (Purple needle grass grassland) Alliance (not mapped and not inventoried in study area)

40'. Stands strongly dominated by non-natives, lacking evenly distributed diagnostic native plants (usually <5% relative cover). Annual *Bromus, Schismus, Avena, Brassica* and other non-native herbaceous species are strongly dominant, with little regular cover of native herb species…
2330 = Mediterranean California naturalized annual and perennial grassland Group (four choices below)…

Locally either *Hirschfeldia incana, Brassica tournefortii* or *Sisymbrium irio* are prevalent dominant species in an herbaceous layer mostly comprised of non-

natives (where shrubs <2% absolute cover and/or not evenly distributed). Usually on sandy substrates, often near road cuts or in clearings, fallow fields, large washes, riverbeds, etc. *Brassica tournefortii* shows up as a straw colored signature over sandy substrates in areas such as Dunn, East of Dale Lake, etc. Can model for exotic class 2 in these settings where *Larrea tridentata* or other alliances still prevail….
2331 = *Brassica nigra* and other mustards (Upland mustards) Semi-natural Stands

Bromus rubens (B. madritensis ssp. *r.)* and/or *Schismus arabicus or S. barbatus* with the highest percent cover of non-native grasses present, generally strongly dominant; without even shrub layer or without even distribution of native desert annual herbs or grasses. In the main part of study area *B. rubens* stands are usually the result of multiple short interval fires in desert scrub such as *Larrea tridentata – Ambrosia dumosa*; *Schismus* tends to dominate on sandier or siltier substrates than *Bromus rubens* and tends to not take up as much area as *Bromus rubens* stands (not usually mappable)…
2332 = *Bromus rubens - Schismus (arabicus, barbatus*) (Red brome or Mediterranean grass grasslands) Semi-natural Stands (not mapped and not inventoried in study area)

2333 = *Lolium perenne* (Perennial rye grass fields) Semi-natural Stands (not mapped and not inventoried in study area)

2334 = *Pennisetum setaceum* (Fountain grass swards) Semi-natural Stands (not mapped and not inventoried in study area)

29'. Vegetation not adapted to Mediterranean climate. Either typically cooler winters (more continental climate), moister summers (ameliorated locally by cool, shady slope exposures, or surface and subterranean runoff), or both. Stands are higher in the mountains or more strictly associated with cooler and moist to wet microsites…
3000 = TEMPERATE AND BOREAL SHRUBLAND AND GRASSLAND SUBCLASS (3000)

41. Stands are upland grasslands, herblands, or shrublands that are not associated with areas of moisture accumulation that could be considered marshes, wet meadows, or swales…
3100 = Western North American Temperate Grassland and Meadow Macrogroup MG048

42. Stands dominated by non-native annual cool season cheat grass (*Bromus tectorum*)…
3110 = Vancouverian and Rocky Mountain naturalized annual grassland Group (now considered part of G600 Great Basin & Intermountain Ruderal Dry Shrubland & Grassland Group)
3111 = *Bromus tectorum* (Cheatgrass grassland) Semi-natural Stands
[Not mapped and not inventoried in study area, but some mixes with *B. trinii* and *B. rubens* were seen in the Antelope Valley. *Note: B. tectorum* is very common as an understory of chaparral and *Juniperus* stands in the higher and cooler margins of the study area and would be likely to form stands if subjected to repeat short interval fires].

42'. Stands dominated by evergreen or deciduous shrubs or by native bunchgrasses…

43. Native perennial grasses such as *Poa secunda* (the only certain member of this group locally) are diagnostic and evenly distributed although may be co-dominant with non-native annuals…
3120 = Western dry upland perennial grassland Group

Poa secunda is dominant or co-dominant with *Bromus rubens* on clayey soils on both flats and north-facing hillslopes along with *Allium* spp., *Claytonia parviflora, Erodium cicutarium, Dichelostemma capitata, Trifolium willdenovii* and/or other herbs. The sole member of this group in the mapping area is the *Poa secunda* Alliance, restricted to the area west and south of Lancaster. Occurs as stands on Tejon Ranch, just across fence-line in west Antelope Valley, and there are probably also large stands nearby (need field verification). If *Eschscholzia* is seen in air photos, always label as *Eschscholzia*, but in other areas that have high natives and no obvious wildflower fields, one might expect this alliance, especially following fire and removal of shrub cover on north-facing slopes as far east as Ord Mountain area…
3122 = *Poa secunda* (Curly or one-sided blue grass grassland) Alliance (not mapped and not inventoried in study area)

3121 = *Elymus multisetus* (Big squirreltail patches) Provisional Alliance (not mapped and not inventoried in study area*)*

3220 = Western Cordilleran montane moist graminoid meadow Group
3221 = *Muhlenbergia richardsonis (*Mat muhly meadows) Provisional Alliance (not mapped and not inventoried in study area)

43'. Shrubs dominant…

44. Winter deciduous shrubs dominant and characteristic…
3200 = Western Cordilleran Montane Shrubland and Grassland Macrogoup MG049 (now called M049 Southern Rocky Mountain Montane Grassland & Shrubland)
3210= Western Cordilleran montane deciduous scrub Group (now called G275 Northern Rocky Mountain Montane-Foothill Mesic Deciduous Shrubland Group)
Ribes quercetorum is the dominant shrub in the canopy, often growing clonally in stands that have resprouted recently after fire on steep or concave north facing slopes. Seen only in small stands in the foothills of Liebre Mountains adjacent to *Ericameria nauseosa, Quercus lobata* and *Q. douglasii* stands. Most stands are <1 acre, so few can be mapped…
3211 = *Ribes quercetorum* (Oak gooseberry thickets) Alliance

44'. Stands characterized by two shrub layers, a moderately open to intermittent cover of sclerophyll shrubs and a shorter layer of drought deciduous subshrubs with at least some presence of xerophylls including *Platyopuntia, Cylindropuntia, Yucca* spp., etc. and presence of many drought deciduous species such as *Ericameria* spp, *Encelia actoni,* etc., which have desert affinities. True Mediterranean California chaparral species such as *Adenostoma, Arctostaphylos*, *and Ceanothus* (other than *C. greggii*), and others are lower in cover or absent, although stands of the California Chaparral Macrogroup may occur adjacent to these stands...
D061 Western North American Interior Sclerophyllous Chaparral Shrubland
3300 = Warm Interior Chaparral Macrogroup MG051

3310 = Western Mojave and Western Sonoran Desert borderland chaparral Group

45. Stands are characterized by *Quercus cornelius-mulleri* and/or *Q. john-tuckeri. Quercus* spp. are ≥2% cover and not exceeded by any other tree cover; however *Juniperus californica* can be almost as high in cover. Note: These two desert scrub oak species, along with the common California chaparral species *Q. berberidifolia* (map code 2132) can be extremely difficult to tell apart in the field and serve similar ecological roles. If two or more scrub oaks are both present (most likely in the Cajon Pass area for *Q. berberidifolia* and *Q. john-tuckeri*) use the sum of their absolute covers and key to the predominant species…

46. *Quercus john-tuckeri* is the dominant oak as a low tree or shrub or it intermixes with similar or higher cover than *Juniperus californica*. A variety of shrubs, such as *Arctostaphylos glauca, Garrya flavescens, Ericameria linearifolia, E. cooperi, Adenostoma fasciculatum, Eriogonum fasciculatum*, etc., may be present at low cover in the shrub layer…
3312 = *Quercus john-tuckeri* (Tucker oak chaparral) Alliance

46'*. Quercus cornelius-mulleri* is dominant, or co-dominant and evenly distributed across the stand. It occurs with a mixture of shrubs including *Eriogonum fasciculatum, Ericameria linearifolia, E. teretifolia,* and *Yucca schidigera.* Stands are limited the vicinity of Morongo Valley and the town of Joshua Tree. These stands are on north- facing slopes and often mix with stands of *Juniperus californica* or *Coleogyne ramosissima*. If *J. californica* and *Quercus cornelius-mulleri* are co-dominant, and stands contain some *Coleogyne ramosissima* and *Achnatherum speciosum*, then key to *Juniperus californica* alliance…
3314 = *Quercus cornelius-mulleri* (Muller oak chaparral) Alliance

3313 = *Quercus palmeri* (Palmer oak) Alliance (not mapped and not inventoried in study area)

45'*. Ceanothus greggii* is dominant or co-dominant in the stand. Although the species has been identified from the study area in the margins of the Transverse Ranges, stands have not been defined…
3311 = *Ceanothus greggii* (Cup leaf ceanothus chaparral) Alliance (not mapped and not inventoried in study area)

41'. Stands dominated by tall to short herbs and graminoids in wet to moist meadows, seasonal ponds, vernal pools, or in regularly to episodically flooded bottomlands or depressions (including saline and alkaline depressions such as playas). Due to the proximity of fresh and saline or alkaline water sources in the study area it is possible for freshwater and salt or alkaline stands to be immediately adjacent to one another. This makes mapping of wetland complexes such as near large playas, rivers, or artificial sources such as water treatment plants, sometimes problematic…

47. Stands restricted to freshwater seeps, marshes, and wet meadows. Stands are of three main types; 1) dominated by tall emergent perennial herbs such as reeds, tules, and cattails found in permanently wet soil or standing water; 2) stands dominated by smaller mostly annual herbs of ephemeral ponds and swales, drying by mid-growing season, and 3) stands dominated by mid-sized perennial wetland graminoids such as rushes (*Juncus* sp.)…

2.C.5 Temperate & Boreal Freshwater Wet Meadow & Marsh
D031 Western North American Freshwater Wet Meadow & Marsh

Type 1 falls within the following macrogroup and group:
3400 = Western North American Freshwater Marsh Macrogoup MG073 (now called Warm Desert Freshwater Shrubland, Meadow & Marsh MG076)
3410 = Arid West freshwater emergent marsh Group
This type has three main mappable categories, listed below:

Phragmites australis, the tall stoloniferous wetland grass, dominates the stand. Most stands are small and occur adjacent to permanent water sources such as springs, flowing streams and rivers. Most are below mappable size for this project, with the exception of the larger stands along the Colorado River. Hybrids between the native races of the American Southwest and non-native Eurasian races are likely in some areas and make conservation prioritization difficult without detailed taxonomic study. Most stands in isolated wetlands appear native…
3411 = *Phragmites australis* (Common reed marshes) Alliance (not mapped and not inventoried in study area)

Schoenoplectus spp. (tall bulrushes) dominate the stand. Small, but often mappable stands occur in all areas of the study where ponds and sluggish permanently flowing water exist. Note: two or more alliances are treated within this mapping unit. It is not possible to map them individually. They have similar ecologies. *S*. acutus occurs in fresh or brackish water; *S. californicus* appears more regularly at edges of open water; and *Bolboschoenus maritimus* (formerly *Scirpus m*., and not represented by a specific map code in this project), the alkali bulrush, occurs in brackish to salty or alkaline water near or on playas such as Coyote Lake…
3412 = *Schoenoplectus (acutus, californicus)* (Hardstem bulrush, California bullrush) Mapping Unit

3413 = *Schoenoplectus acutus* (Hardstem bulrush marsh) Alliance (not mapped and not inventoried in study area)

3414= *Schoenoplectus californicus* (California bulrush marsh) Alliance

Typha spp. dominate stands in the tall herb layer. Most stands growing within water with slightly alkaline or saline chemistry are *T. domingensis*. Stands of *T. latifolia* have only been inventoried in fresh water at Lost Lake (Cajon Pass region)…
3415 = *Typha (angustifolia, domingensis, latifolia)* (Cattail marshes) Alliance

Type 2 is probably restricted to the Antelope Valley region and is likely present but due to inaccessibility, no certain stands were inventoried. Three polygons (all privately owned and not accessible) are mapped as vernal pools or swales in this area. If accurate, these would likely be similar to those of the southern San Joaquin Valley or the inner south Coast Ranges, farther west and outside of the study area. Landscapes with pools and swales near Rosamond and north of Lancaster, which contain an even distribution of low cover *Atriplex confertifolia* over *Lasthenia* and other native herbs are keyed in the *A. confertifolia* alliance (couplet 67)…
3500 = Western North America Vernal Pool Macrogroup MG074

3510 = Californian mixed annual/perennial freshwater vernal pool/swale/plain bottomland Group

One particular alliance that may possibly occur in the area is characterized by the summer or late spring flowering *Deinandra fasciculata*. No verified occurrences of this type have been seen in the area…
3511 = *Deinandra fasciculata* (Clustered tarweed fields) alliance (not mapped and not inventoried in study area)

Type 3 is composed of mid-sized grasses and graminoids, characteristic of moist to wet meadows and marsh edges with fresh to slightly alkaline or saline water chemistry. Most stands are small, although some meet MMU requirements and have been mapped.
3600 = Western North America Wet Meadow and Low Shrub Carr Macrogoup MG075 (now called Western North American Montane & Subalpine Wet Shrubland & Wet Meadow)
3610 = Californian warm temperate marsh/seep Group (three choices below)...

Juncus arcticus, the dark brownish-green rhizomatous rush, is dominant and characteristic. Stands may include similar to lower cover of other native and non-native herbs, but *J. arcticus* is prevalent throughout. Largest mappable stands occur in the Silverwood Lake area and around seeps and springs such as on the west side of Coyote Lake and Paradise Springs…
3611 = *Juncus arcticus (var. balticus, mexicanus)* (Baltic and Mexican rush marshes) Alliance

Leymus triticoides, the pale green creeping grass, characterizes the stands. Stands are usually too small to map and often occur adjacent to edges of permanent wetlands (when the group 3610 or Macrogroup 3600 categories are acceptable) or riparian woodland as near Victorville. May be saline, alkaline, or fresh water. Usually in slightly drier conditions than *Juncus arcticus*…
3612 = *Leymus triticoides* (Creeping rye grass turfs) Alliance (not mapped and not inventoried in study area)

Muhlenbergia rigens, the midsize tufted perennial grass, characterizes the stand. No mappable stands have been seen within the study area, but very small stands exist in the upper Mojave River drainage upstream from Silverwood Lake...
3613 = *Muhlenbergia rigens* (Deer grass beds) Alliance (not mapped and not inventoried in study area)

47'. Stands restricted to marshes or episodic wetlands that concentrate salts or alkaline minerals. Many stands are too small to effectively be mapped...
2.C.6 Salt Marsh.

48. Stands are wet, flooded, or at least moist throughout the growing season and support dense herbaceous growth…
3700 = Warm Semi-Desert/Mediterranean Alkali–Saline Wetland Macrogroup MG083
3710= Southwestern North American alkali marsh/seep vegetation Group

49. *Juncus* spp. (rushes) or *Schoenoplectus* or *Bolboschoenus* (bulrushes) dominate the stands (two choices below)…

Vegetation of saline or alkaline marsh vegetation dominated by densely tufted *Juncus cooperi* (similar to *J. acutus* of s coastal California). Most stands occur to the east of our study area in the Death Valley-Soda Lake Trough in the eastern Mojave Desert…
3714 = *Juncus cooperi* (Cooper's rush marsh) Alliance (not mapped and not inventoried in study area)

Schoenoplectus americanus, a vivid green triangular stemmed bulrush, forms open to dense stands in moist to flooded borders of saline or alkaline marshes in basins or near playas, such as China Lake. Large stands also mix with *Bolboschoenus maritimus* in seeps below the water treatment storage ponds north of Lancaster (edge of Edwards Air Force Base). Local stands of alkali bulrush (*Bolboschoenus maritimus* or *B. robustus*) also occur in a few areas of the mapping area, including Harper Lake Wildlife Observation area, the center of Coyote Dry Lake, and the tail below the Lancaster waste water ponds on the border of Edwards Air Force Base. Currently these are being treated as members of the bulrush mapping unit …
3715 = *Schoenoplectus americanus* (American bulrush marsh) Alliance

49'. Stands characterized by *Anemopsis californica, Spartina gracilis, Sporobolus airoides,* or *Distichlis spicata.* Stands in moist meadows and flats often associated with alkaline water and stands of *Distichlis spicata, Schoenoplectus americanus*, or *Juncus arcticus*, but none of these species are dominant. Stands are small and uncommon, with none known to be large enough to be mapped in this study. Individual stands occur in the vicinity of Victorville near the Mojave River narrows some in actively grazed irrigated meadows (four choices below)…

3713 = *Anemopsis californica* (Yerba mansa meadows) Alliance (not mapped and not inventoried in study area)

3711 = *Spartina gracilis* (Alkali cordgrass marsh) Alliance (not mapped and not inventoried in study area)

Sporobolus airoides may occur as small stands in *Atriplex confertifolia* stands near Hwy 14 and west side of Edwards Air Force Base…
3712 = *Sporobolus airoides* (Alkali sacaton grassland) Alliance

Although formally considered part of the next group (3720 = Southwestern North American salt basin and high marsh Group), *Distichlis spicata,* the short rhizomatous salt grass, is likely to be seen adjacent to episodically flooded basins, springs, playas, and salt marshes, sometimes without visible salt deposits on the surface. Mappable stands occur at Harper Lake and several other sites in the study area…
3726 = *Distichlis spicata* (Salt grass flats) Alliance

48'. Stands usually restricted to alkali or salt basins, margins of springs, or river terraces where salt deposits or alkali deposits are often present…
3720 = Southwestern North American salt basin and high marsh Group

50. Stands are dominated by succulent stemmed herbs or shrubs in the Chenopod family. Leaves are usually scale-like and inconspicuous.

Restricted to salty basins that may be seasonally inundated or saturated (two choices below)…

Allenrolfea occidentalis has the highest cover (often >2% absolute cover) in the shrub canopy OR has similar cover to *Suaeda moquinii*, *Atriplex confertifolia,* or *A. canescens.* Occurs on saline playas and margins of salt pannes. Can occur in hummocks that are widely spaced on relatively flat playas like China Lake. Stands may also form borders around edges of playas on edges of stabilized dunes. In general, stands in the Mojave and Colorado deserts have small, low, and widely to intermittently spaced shrubs, but stands at China Lake may be denser and have a *Distichlis* understory…
3721 = *Allenrolfea occidentalis* (Iodine bush scrub) Alliance

The annual pickleweed, *Salicornia depressa,* is the dominant herb. No other species approaches cover of *S. depressa*. In winter, skeletons of the annual plants are usually visible to confirm identification. The only stands known are at Harper Lake, probably adjacent to *Suaeda moquinii* and enhanced (trenched and watered) *Bolboschoenus* stands. Based on the imagery used for this project, stands were not mappable…
3727 = *Salicornia depressa* (Pickleweed flats) Herbaceous Alliance
(not mapped and not inventoried in study area)

50'. Stands are dominated by shrubby members of the Chenopod family without succulent stems or by other species of shrubs or herbs without succulent stems. Stands are rarely inundated or if so briefly, compared to the above couplet 50…

51. Stands dominated or characterized by shrubby members of the genus *Atriplex* (three choices below)…

Stands strongly dominated (typically >60% relative cover) by *A. lentiformis*. Stands are uncommon and are of two kinds. The tall, broad, bushy form of *A. lentiformis* ssp. *lentiformis* occurs on river terraces adjacent to *Populus fremontii* stands near Victorville below the Mojave River narrows mixed with *A. polycarpa*, and *A. canescens*. Rare small stands of *A. lentiformis* ssp*. torreyi* (New Mexico saltbush) occur on the beds of dry lakes. Mapping sites of *A. lentiformis* ssp*. torreyi* might be in Edwards, Lucerne, Koehn, or perhaps China lakes, locally. Charlton (in Lichvar et al. 2004) states: New Mexico saltbush is strongly associated with specific environments and occurs as pure stands in clay washes and on the playa edge where drainages empty out into the playa. New Mexico saltbush is commonly associated with shadscale or spinescale in communities adjacent to washes in or near playas. *A. lentiformis* ssp. *torreyi* is usually associated with *Suaeda moquinii* and/or *Atriplex canescens.* If *Suaeda mosquinii* is dominant to co-dominant, key to *Suaeda.* Charlton (at Edwards AFB) has a description of a *Suaeda*–*Atriplex lentiformis* ssp. *torreyi* Shadscale Association. Strong dominance by *A. confertifolia* keys to *Atriplex confertifolia*...
3722 = *Atriplex lentiformis* (Quailbush scrub) Alliance

Atriplex spinifera (spinescale saltbush) dominates or co-dominates with *A. polycarpa, Larrea tridentata,* or *Ambrosia dumosa* in the shrub canopy. When *A. confertifolia* is co-dominant with *A. spinifera,* key to *A. confertifolia.* The herb layer has open to intermittent cover

and may include *Bromus rubens, Erodium cicutarium* and *Lasthenia*. *Atriplex spinifera* prefers fine-textured silty or clay soils that are not strongly alkaline or salty; stands tend to have evenly-spaced, moderate-sized shrubs with small gray clay lenses scattered throughout, and not highly reflective whitish pannes. Spinescale may occur with *Artemisia spinescens* and *Lepidium fremontii* near playa lakebeds, where either of these additional species may co-dominate. Occasionally, stands may occur in less silty and sandier soils as near Hinkley and Helendale (west of Barstow) where one would normally predict *A. polycarpa*. Stands may be extensive or can occur in a fine matrix with *Ambrosia dumosa* (present or co-dominant), *Atriplex polycarpa*, and *Krascheninnikovia lanata* (e.g., in Four Corners area north to Cuddyback Lake). *Lasthenia gracilis* or *Coreopsis calliopsidea* may be the dominant annuals associated with *Atriplex spinifera* in the spring. *Atriplex spinifera* often occurs on hydrophobic soils that saturate to only a few centimeters during the rainy season. The soil surface remains moist throughout spring. These conditions favor the development of the blacktop form of cryptobiotic crust. Sensitive species observed in this community include Mojave spineflower *(Chorizanthe spinosa)* and crowned onion *(Muilla coronata)…*
3723 = *Atriplex spinifera* (Spinescale scrub) Alliance

Stands are strongly dominated by the mid-sized shrub *Atriplex parryi.* Stands are only mappable at China Lake where they occur in alkaline basins on fine textured soils just upslope from *Allenrolfea occidentalis* stands or down slope from the *Atriplex confertifolia* stands. Small stands (not mappable) have been noted within larger *A. confertifolia* stands at Coyote Lake, and with *A. spinifera* near California City…
3729 = *Atriplex parryi* (Parry's saltbush) Provisional Alliance

51'. Stands dominated by either the low subshrub *Frankenia salina*, the taller succulent leaved *Suaeda moquinii* or the low grass *Distichlis spicata* (four choices below)…

Frankenia salina is dominant or co-dominant (>30% relative cover) in playas, alkaline depressions and alkali sinks that have seasonally moist, poorly drained soils. *Atriplex* spp., *Cressa truxillensis* and other species may be present. Stands are part of the high marsh vegetation in southern California salt marshes; inland they occur on alkaline flats. In our study area, they are often intermixed with *Bassia, Salsola*, or other alkali- tolerant weeds. Stands of mappable size are unusual in the study area; they are relatively uncommon at Harper and China Lakes, and usually below 1 acre in size…
3724 = *Frankenia salina* (Alkali heath marsh) Alliance

Suaeda moquinii characterizes stands, typically with ≥2% cover (it may have lower cover in shrub stands with a sparse canopy). *Suaeda moquinii* is evenly distributed with no other native shrub or tree species having greater cover. If *Suaeda moquinii* and either *Atriplex confertifolia* or *A. lentiformis* ssp. *torreyi* co-dominate, the alliance is *Suaeda*. If *Suaeda moquinii* and *Allenrolfea occidentalis* co-dominate, the alliance is the latter. Where wind-blown salts are deposited, *Suaeda moquinii* and *Kochia* may co-occur (Rosemond and China Lakes), and in these cases should be mapped as the

Suaeda moquinii alliance - there is no *Kochia* alliance defined yet. Stands typically occupy strongly alkaline playas, usually with distinct salt deposits on the soil surface, but may occur in upland areas adjacent to playas (e.g., Lucerne Lake). Stands often create fine-scale drainage patterns in cracks in lake beds. They are mapped as low cover (1-5% shrub) over broad areas in such situations (as at Coyote Lake)…
3725 = *Suaeda moquinii* (Bush seepweed scrub) Alliance

Distichlis spicata with ≥2% cover and typically dominant or co-dominant in the herb layer; though, non-native herbs may be present with moderately higher cover. Soils are often deep, alkaline or saline, and poorly drained. A variety of native and non-native forbs and grasses may be present. *Distichlis spicata* is restricted to moderate to strongly alkaline and saline soils. Large (>5 ha, 12 ac) stands do occur at Harper Lake (the south shore margin has a stand >100m (300ft) wide for >4 ha or 10 acres). Stands are associated with alkali springs, playa and panne margins…
3726 = *Distichlis spicata* (Salt grass flats) Alliance

Isocoma acradenia is dominant on flat to gentle slopes near salty margins of dry lakes and playas or on episodic alkaline outwash deposits from springs and seeps. Larger stands occur on western shore of Coyote Lake and some at China and Lucerne Lakes (they may not always be mappable due to small size and intermixing with *Atriplex confertifolia*, *A. parryi*, and *Suaeda moquinii* stands)…
3728 = *Isocoma acradenia* (Alkali goldenbush) Alliance

28'. Vegetation is defined by scrubs and occasional grasslands within the warm and cold desert of California. Diagnostics usually exhibit characteristics of xeromorphy and are naturally distributed in scrubs and grasslands with lower overall cover than mesomorphic (class 1000 or 2000) vegetation…
SEMI-DESERT CLASS

52. Principal indicator species are adapted to very hot dry summers and mild winters, characteristic of the majority of the lower to mid elevations of the Mojave, Sonoran and Colorado deserts. The main indicator genera include: *Ambrosia, Acacia, Chilopsis, Encelia, Larrea, Hyptis, Senna, Parkinsonia, Olneya, Ferocactus, Psorothamnus,* and *Krameria*. Stands with emergent *Yucca brevifolia* over higher, more uniform cover of sclerophylls (*e.g.*, *Fremontodendron, Adenostoma,* or shrubby *Quercus*) key to chaparral. If stands do not meet these criteria, please go to couplet 52'.
4000 = WARM SEMI-DESERT SCRUB AND GRASSLAND SUBCLASS

53. Vegetation of the lower slopes, fans and small sheet flow areas of the warm desert parts of the state, but not of well-defined washes or arroyos with clear banks and channels. Dominated or co-dominated by small to moderate sized shrubs (or perennial grasses) of the genera *Ambrosia, Encelia, Larrea, Senna, Parkinsonia, Olneya, Ferocactus, Psorothamnus* and *Krameria.* If *Yucca*, *Salazaria, Grayia,* or *Ephedra nevadensis* are present, they have equal or lower cover and are overshadowed by members of the aforementioned genera. Winters may experience short frosts, but generally are not subject to persistent freezes and snow accumulation…
4100 = Mojavean–Sonoran Desert Scrub Macrogroup MG088
4110 = Lower Bajada and Fan Mojavean–Sonoran desert scrub Group

54. *Ambrosia dumosa* covers ≥2% (rarely 1% in very sparse stands) of a single stand and exceeds any other shrub in cover with the exception of *Grayia spinosa*. Stands

lack significant cover of *Larrea tridentata* or *Larrea* cover is patchy and not uniformly distributed and ≤2% absolute cover. When *Krascheninnikovia lanata, Ericameria cooperi, Tetradymia spp.,* or *Eriogonum fasciculatum* (but not *Grayia spinosa,* or *Atriplex spinifera*) are co-dominant they fall within the *Ambrosia dumosa* alliance. Stands are either on uplands with relatively fine-textured soil or in active washes or terraces adjacent to medium to large washes. They also may occur on steep slopes with neutral or southerly exposures (but not too bouldery). In the West Mojave (especially the northwestern portion of the mapped area) stands often result from fire or clearing of *Larrea* in formerly mixed *Larrea tridentata – Ambrosia dumosa*. Many stands commonly occur mixed with *Krascheninnikovia lanata, Grayia spinosa, Ambrosia salsola, Ericameria cooperi*, and other species of "bathtub ring" shrubs above *Atriplex spinifera* or *A. polycarpa* and below *Larrea tridentata – Ambrosia dumosa* of mid- or upper fans…
4111 = *Ambrosia dumosa* (White bursage scrub) Alliance

54'. *Ambrosia dumosa* may be present, either co-dominant with, or have less cover than *Atriplex*, *Larrea tridentata, Encelia, Pleuraphis*, *Tidestromia oblongifolia, Viguiera,* or *Cylindropuntia* spp…

55. *Atriplex polycarpa* typically has the highest shrub cover, usually with ≥2% cover and >50% relative shrub cover. Scattered along broader washes and on adjacent terraces. May occur on playa edges, in washes through alkaline areas, or occasionally uplands with alkaline substrate. Stands can occur on broad flats, in washes, or on steep volcanic ravines and slopes. In this alliance, *Atriplex polycarpa* is dominant in the shrub canopy if these shrubs are present: *Ambrosia dumosa*, *A. salsola*, *Atriplex canescens*, *Chamaesyce polycarpa, Cleome isomeris, Isocoma acradenia*, and *Larrea tridentata*. Emergent *Prosopis glandulosa* trees may be present at low cover. If *A. spinifera* is co-dominant with *A. polycarpa* in a stand, key to *A. spinifera*…
4113 = *Atriplex polycarpa* (Allscale scrub) Alliance

55'. *Atriplex polycarpa* is not dominant, conspicuous or evenly spaced…

56. *Encelia farinosa* is dominant, usually with ≥2% cover and no other species having equal or higher cover – though *Ambrosia dumosa* may occasionally be co-dominant. *Larrea tridentata* is absent or clearly sub-dominant. *Ambrosia dumosa* and *Fagonia laevis* have been noted as associated species. Stands occur on mid to upper (most exposed) hot and dark rocky substrate on south- facing slopes, of the southern or lowest elevation parts of the study area (as far north as Trona and Spangler Hills, south side of Alvord Mountains, Paradise Range, and south side of Sidewinder Mountains near Lucerne). Usually bordered by *Larrea tridentata – Encelia farinosa* Alliance on slightly less exposed slopes (lower or less steep adjacent slopes) and giving way to *Larrea tridentata – Ambrosia dumosa* Alliance on more neutral slopes…
4114 = *Encelia farinosa* (Brittle bush scrub) Alliance

56'. *Encelia farinosa* is not dominant. If present, it is co-dominant with *Larrea tridentata* or sub-dominant to absent with other shrubs…

57. *Larrea tridentata* and *Encelia farinosa* are both present and often in similar cover (broadly co-dominant), although when *E. farinosa* is sub-dominant to *Larrea tridentata,* then *A. dumosa* also has very low cover or is absent. *Larrea tridentata, Encelia farinosa,* and sometimes *Ambrosia dumosa* co-dominate, sometimes along with these other conspicuous or co-dominant warm desert rupicolous shrubs: *Pleurocoronis pluriseta,*

Viguiera parishii, Trixis californica, and *Simmondsia chinensis.* Stands sometimes have *Ambrosia dumosa, Hyptis emoryi*, or *Acacia greggii* as a third co-dominant. Usually in rocky/bouldery uplands or on well-drained bajadas…
4118 = *Larrea tridentata* – *Encelia farinosa* (Creosote bush - brittle bush scrub) Alliance

57'. *Encelia farinosa* does not have significant cover with *Larrea tridentata* or other shrubs…

58. *Larrea tridentata* is either co-dominant with *Ambrosia dumosa*, the sole dominant shrub, or is the sole indicator with other mixed shrub species. *Yucca* species are generally less than 1% and not evenly distributed…

59. *Larrea tridentata* and *Ambrosia dumosa* broadly characterize a stand, with both species being evenly distributed across the landscape. In combination, the two species clearly dominate when their covers are added. However, mapping aggregations sometimes take into account mixes of *Larrea tridentata* without *Ambrosia dumosa* or *Ambrosia dumosa* without *Larrea tridentata* if they occur in fine scale patches within broader *Larrea tridentata – Ambrosia dumosa* stands. *Ambrosia dumosa* is conspicuously present (≥1% cover) as a short shrub between evenly spaced *Larrea*. *Ambrosia dumosa* occasionally has higher cover than *Larrea tridentata*. If *Encelia farinosa* is present, it is sub-dominant. *Yucca schidigera,* if present, is <1% cover or is unevenly distributed (if it has higher cover and/or is evenly distributed, see the *Yucca schidigera* Alliance). *Atriplex polycarpa* can be co-dominant. Widespread on all but the hottest, rockiest, sandy, or alkaline areas of the middle and lower elevations. Do not expect the *Larrea tridentata – Ambrosia dumosa* Alliance on old alluvial surfaces where *A. dumosa* tends not to grow. Map older alluvial fans with interfluves as *Larrea tridentata* rather than *Larrea tridentata – Ambrosia dumosa*. Stands tend to occur on north-facing slopes at the lowest and hottest exposures, where south-facing slopes would be *Larrea tridentata – Encelia farinosa* or *Encelia farinosa*. Only occurs on shadier, extremely dry, north-facing exposures in the Colorado Desert…
4115 = *Larrea tridentata* – *Ambrosia dumosa* (Creosote bush - white burr sage scrub) Alliance

59'. *Larrea tridentata* is the dominant shrub with at least 2% cover (rarely 1% cover in stands with a very sparse shrub canopy) and is evenly distributed in the stand. *Ambrosia dumosa* and/or *Encelia farinosa* are clearly sub-dominant if present. Other associated shrubs may include *Krameria* spp., *Bebbia juncea*, *Ericameria teretifolia*, *Acamptopappus sphaerocephalus*, *Ephedra nevadensis* or *Opuntia acanthocarpa…*
4119 = *Larrea tridentata* (Creosote bush scrub) Alliance

58'. *Larrea tridentata* may be present but if so, at least one of the following shrubs is present in significant cover*: Tidestromia oblongifolia*, *Pleuraphis rigida* (actually a shrubby grass), *Brickellia*

desertorum, Tetracoccus hallii, Peucephyllum, *Viguiera, Salazaria,* or *Yucca…*

60. The small, stellate-pubescent subshrub, *Tidestromia oblongifolia* is unlikely to form major stands in the study area, but stands have been inventoried east of this area. They occur on sand ramps and dune aprons in hot and very dry locations tending to have <5% perennial cover. There are no mapped polygons in our project area…
4121 = *Tidestromia oblongifolia* (Arizona honey sweet sparse scrub) Provisional Alliance (not mapped and not inventoried in study area)

60'. Species other than *Tidestromia* are characteristic of the stands…

61. The shrubby grass *Pleuraphis rigida* is the dominant perennial species and can be considered in the same layer as commonly occurring shrubs such as *Larrea, Ambrosia dumosa, Ephedra trifurca,* or other species. Stands are often mixed with lower cover of other shrubs and found on sand ramps, dune aprons, stabilized dunes near playas, or wide washes adjacent to *Larrea tridentata-Ambrosia dumosa* stands. Sandy stands adjacent to freeways and disturbance often have a significant non-native component of *Brassica tournefortii, Schismus* spp, etc. Stands are not often separable from the *Larrea tridentata-Ambrosia dumosa*/*Pleuraphis rigida* Association, but may occasionally be large enough to map in the far eastern portion of map area. The western-most occurrence of this type is west of Barstow near Hinkley…
4122 = *Pleuraphis rigida* (Big galleta shrub-steppe)

61'. Stands of rocky or bouldery hills and lower mountains. Dominated or co-dominated by either *Viguiera parishii* or by *Brickellia desertorum* (two choices below)…

Viguiera parishii with ≥1 percent cover. No other species with greater or equal cover, except for *Acacia greggii, Ambrosia dumosa, Simmondsia chinensis, Pleuraphis rigida, Lotus rigidus, or Encelia actoni.* Usually on rocky slopes in areas with cobbles, boulders, and/or outcrops at low to mid elevations or, rarely, in washes. Occurs on northerly slopes of the Mojave and Sonoran Desert in California. Found just above the *Larrea tridentata – Ambrosia dumosa* Alliance or in washes in the east Mojave Desert. Generally at the higher edge of the *Larrea tridentata-Ambrosia dumosa* zone on bouldery, often granitic slopes in the southeast portion of study - not found elsewhere in our study area. [Note: this shrub is usually non-descript to photointerpreters and tends to co-dominate with several of the above listed shrub species]…
4151 = *Viguiera parishii* (Parish's goldeneye scrub) (within 4150 = Arizonan Upland Sonoran Desert Scrub Group)

Brickellia desertorum occurs on steep, colluvial or boulder-strewn slopes of granitic or volcanic rocks; usually with relatively large, but scattered shrubs amongst rocks and boulders. Often associates with *Ericameria teretifolia, Atriplex polycarpa,* and may be adjacent to *Larrea tridentata* or *Larrea tridentata* – *Ambrosia dumosa*. Appears to resprout or recolonize after fires. Technically a sparsely vegetated rock outcrop type. Map when there are not enough other definitive shrubs of other alliances on boulders or recently burned slopes (grass carries the fires up into the rocks)…
4123 = *Brickellia desertorum* (Desert brickellbush scrub) Alliance (not mapped and not inventoried in study area)

53' Vegetation of well-defined desert washes that shows distinct changes in plant composition and/or cover from adjacent upland vegetation stands. These washes may be broad and many-channeled or narrow and contain one or a few channels. They may occur in hills, flow across moderate sloping fans, or have a barely discernable slope and meander across lower toeslopes or basins. Diagnostic species include *Ephedra (californica* or *trifurca), Lepidospartum squamatum, Ericameria paniculata, Ambrosia salsola, Prunus fasciculata, Brickellia incana, Artemisia tridentata* ssp*. parishii*, *Acacia greggii, Hyptis emoryi, Prosopis glandulosa P. pubecens*, *Chilopsis linearis*, *Psorothamnus spinosus*, *Parkinsonia florida*, and *Olneya tesota*...
4200 = Madrean Warm Semi-Desert Wash Woodland/Scrub Macrogroup MG092
[Note: there are many warm and cool desert alliance indicators that may occur in washes, including *Larrea tridentata, Ambrosia salsola, Salazaria mexicana, Lycium cooperi, Atriplex polycarpa, A. canescens,* etc. This macrogroup is defined based on a series of indicators which are largely diagnostic of washes. Although it does exclude other alliances with broad ecological tolerances, this does not by any means exclude other alliances from occurring in washes on occasion].

62. Vegetation of washes and dominated by, co-dominated by, or containing evenly distributed shrubs of the following species: *Ephedra (californica* or *trifurca), Lepidospartum squamatum, Ericameria paniculata, Ambrosia salsola, Prunus fasciculata, Brickellia incana, Artemisia tridentata* ssp. *parishii* or *Bebbia juncea*...
4210 = Mojavean semi-desert wash scrub Group

63. Vegetation either dominated or co-dominated by *Ephedra californica* or *Ephedra trifurca. Senna armata* and *Ambrosia salsola* may intermix with similar or even higher shrub cover*. Ephedra californica* is typically of broad, active washes of mid to upper bajadas and fans, and this species may be confused with the similar *Ephedra trifurca* of washes and sand dunes from Barstow eastward. *E. trifurca* is characteristic of low dunes and sand-sheets in the Colorado Desert but generally attains higher cover than vegetation types in the lithomorphic class that includes sparsely vegetated dunes. Due to similar ecology, both species are treated together in this *Ephedra californica* alliance. Stands dominated by *Senna armata,* with either species of *Ephedra* intermixing as an evenly distributed and important shrub, are also currently placed in this alliance (new evidence, following the conclusion of the field work for this project, suggests *Senna armata* may be a separate type)…
4211 = *Ephedra californica* (California joint fir scrub) Alliance

63' Vegetation not dominated or-co-dominated by *Ephedra californica* or *E. trifurca…*

64. Vegetation characterized by *Lepidospartum squamatum.* Stands are concentrated along washes on the eastern base of the San Bernardino, San Gabriel and southern Sierra Nevada Mountains. Usually in larger washes with regular flooding, the substrate texture is coarse sand to small cobbles to gravel. Stands rarely occur well out into the desert (except along the Mojave River) and are usually at the bases of mountains in arroyos or on upper fans. [Note: Compare with *Ericameria paniculata, Ambrosia salsola, and Chilopsis linearis* alliances]…
4212 = *Lepidospartum squamatum* (Scale broom scrub) Alliance

64' Vegetation not dominated by *Lepidospartum squamatum* but instead is dominated or characterized by *Ericameria paniculata, Prunus fasciculata, Brickellia incana, Ambrosia salsola, Artemisia tridentata* ssp. *parishii* or *Bebbia juncea* (six choices below)...

> *Ambrosia salsola* characterizes stands and typically has the highest cover (usually >50% relative cover in dominant shrub layer). *Ambrosia salsola* may mix with equal or somewhat higher amounts of *Senna armata* in washes and still be considered *A. salsola* alliance (however, new evidence, following the conclusion of the field work for this project, suggests *Senna armata* may be a separate type in the northwest Mojave, found in the Spangler Hills and the vicinity of Red Rock Canyon State Park). If *A. salsola* is co-dominant with *Eriogonum fasciculatum*, key to the *E. fasciculatum* Alliance. Stands of washes or disturbed uplands. Upland stands are usually associated with fire, clearing, or other disturbance in former *Larrea tridentata-Ambrosia dumosa*, *Juniperus californica, Yucca schidigera, Coleogyne ramosissima* or other upland vegetation. Most non-fire related stands of *A. salsola* are associated with washes in mid and lower elevations. For this project, stands in washes were >5 acres in order to map. If they were smaller, they were mapped with the adjacent best-wash indicator (e.g., *Ericameria paniculata, Chilopsis linearis, Ephedra californica, Psorothamnus spinosus, Prosopis glandulosa,* etc*)...*
> **4216 = *Ambrosia salsola* (Cheesebush scrub) Alliance**
>
> *Ericameria paniculata* ≥2% absolute cover and/or ≥ 25% relative cover. Widespread throughout a broad elevation range in much of the mapping area, in relatively large, recently active washes. Usually in lower energy portions of washes than *Lepidospartum squamatum* and, if mixed with it, then >2 times the cover of it to make this alliance. If a stand is below MMU and adjacent to a *Chilopsis linearis* stand, subsume it into the *Chilopsis* map polygon…
> **4213 = *Ericameria paniculata* (Blackstem rabbitbrush) Alliance**
>
> *Prunus fasciculata* ≥2% absolute cover and ≥25 percent of total relative cover. *Gutierrezia sarothrae* and *Lycium cooperi* may have higher cover (up to 2x). If *Prunus fasciculata* co-occurs with other tall shrubs such as *Acacia greggii*, it must have twice the cover of other species to make the alliance definition. Usually of upper elevations (above 1000m, 3000ft) and usually in mountains in well defined canyons or valley bottoms. Typically of washes and arroyos but may occur on wash terraces or on concave rocky slopes. Cover may be high following resprouting from fire. The following species are common associates: *Salazaria mexicana, Ericameria teretifolia, Lycium cooperi, Yucca schidigera, Rhus trilobata,* and *Purshia tridentata.* Occurs adjacent to *Eriogonum fasciculatum,*

Grayia spinosa, or *Salazaria mexicana* stands, and also occurs adjacent to *Artemisia tridentata* stands near base of San Gabriel Mountains...
4214 = *Prunus fasciculata* (Desert almond) Alliance

Rarely strongly dominant, *Brickellia incana* usually occurs with *Ephedra californica*, and may be a part of *Ephedra californic*a alliance. It occurs in sandy washes in the Central Mojave, usually at mid to lower elevations as around Coyote Lake, and south of Barstow. Some large stands strongly dominated by *B. incana* occur in areas without *E. californica,* as seen in the hills northwest of the Hodge Road exit off of Interstate 15, between Victorville and Barstow.
4215 = *Brickellia incana (*Woolly brickellia) wash scrub Provisional Alliance

Artemisia tridentata ssp. *parishii* is the dominant shrub. Stands may have *Atriplex canescens, A. polycarpa, A.confertifolia* or *Ericameria nauseosa,* or and may have emergent *Forestiera or Prosopis* with low cover or widely scattered distribution. Small, usually linear stands associated with low gradient channels and washes around Lancaster-Palmdale. Associated with *Prosopis glandulosa* on Edwards AFB, and with *Forestiera and Atriplex polycarpa* on finer soils west and north of Lancaster. This vegetation is often habitat for the rare species, *Calochortus striatus.* Mapped if ≥1 acre in size [Note: see 69 for stands dominated by *Artemisia tridentata* ssp. *tridentata*]…
4217 = *Artemisia tridentata* ssp*. parishii* (Parish's sagebrush) Provisional Alliance

Bebbia juncea is the dominant shrub along rocky washes or on rocky slopes, often occupying sites following disturbance such as fire and clearing. Stands may include *Hyptis emoryi, Parkinsonia florida,* or other woody species at low cover…
4218 = *Bebbia juncea* (Sweet-bush scrub)

62'. Wash or wetland margin vegetation of the warmer desert parts of the study area. Shrubby "trees" of mesquite (*Prosopis glandulosa* or *P. pubescens*), desert willow (*Chilopsis linearis*), smoke tree (*Psorothamnus spinosus*), paloverde (*Parkinsonia florida*), ironwood (*Olneya*) or tall wash or wetland shrubs such as *Pluchea sericea* and *Hyptis emoryi* characterize these stands. Usually found in areas that concentrate water such as edges of springs, river terraces, washes, etc. It is important to note that all of these taller desert woody plants are considered "trees" and thus require only a minimum of 2% absolute cover (evenly distributed) to be considered the dominant layer. This is true even if the lower shrub or herb layer is noticeably higher in cover...
4220 = Sonoran-Coloradan semi-desert wash woodland/scrub

65. Stands dominated by generally large woody plants that tend to be taller or broader than the typical *Larrea tridentata.* These include mesquite (*Prosopis glandulosa* or *P. pubescens*), desert willow (*Chilopsis linearis*), smoke tree (*Psorothamnus spinosus*), paloverde (*Parkinsonia florida*), or ironwood (*Olneya*) (five choices below)...

Prosopis glandulosa and/or *Prosopis pubscens* typically ≥2% absolute cover (rarely 1% in stands with sparse total canopy cover) as the dominant woody plant(s) - not exceeded in cover by any other species of microphyllous tall shrub or tree. In *P. glandulosa* stands, understory shrubs may exceed *P. glandulosa* in cover, including species such as *Atriplex canescens, Atriplex*

polycarpa, Larrea tridentata, Pluchea sericea, and *Suaeda moquinii. Prosopis glandulosa* is usually associated with stabilized dunes or sand sheets adjacent to playas or basins and is mapped even if stands have very low vegetative cover, especially if there is evidence of recent die-off due to dewatering via ground pumping, etc. Stands along the Mojave River near Daggett-Yermo are almost completely dead, but are mapped if possible. Due to similar ecology and sporadic occurrence as a type, *Prosopis pubescens* is treated in the *P. glandulosa* Alliance. Furthermore, *P. pubescens* is associated with stands of the usually more abundant *P. glandulosa*. Small stands have been noted for Barstow near the Mojave River, Paradise Springs, and a few other areas. The only large stands seen were along the Colorado River in the Colorado River Indian Reservation…
4222 = *Prosopis glandulosa* (Mesquite bosque, mesquite thicket) Alliance

Stands characterized (1% or higher cover) by *Chilopsis linearis. Chilopsis* usually has higher cover than any other large shrub/small tree, although stands may contain similar cover of *Acacia greggii* and/or *Prunus fasciculata.* Occurs in washes, intermittent channels, arroyos, or lower canyons that are intermittently flooded. Stands rarely at permanent springs or seeps and not usually associated with *Populus fremontii, Salix* spp., or other true riparian species; adjacent to *Ericameria paniculata, Ephedra californica, Ambrosia salsola,* and *Atriplex polycarpa or A. canescens* stands in washes as far west as Daggett along the Mojave River. Stands tend to occupy sandy or gravelly washes where wash energy is dissipated across a relatively wide flood path. It does not range up into the mountain valleys and narrow arroyos as much as the *Acacia greggii* or *Prunus fasciculata* Alliances, and does not tend to occupy the most active wash centers, as do the *Psorothamnus spinosus, Ericameria paniculata, or Ambrosia salsola* Alliances...
4224 = *Chilopsis linearis* (Desert willow woodland) Alliance

Psorothamnus spinosus is consistently distributed in low energy washes (normally at >1%, but occasionally lower). No other tall shrub or short tree species with greater cover. *Chilopsis linearis* may occur in some stands at equal cover. *Larrea tridentata* or *Ambrosia salsola* may be similar or higher in cover. Only in eastern part of study area on lower or mid fan wash systems out of Newberry Mountains or Twentynine Palms area. Usually associated with *Ericameria paniculata* or *Ambrosia salsola* washes, occasionally with *Ephedra californica* stands.
4225 = *Psorothamnus spinosus* (Smoke tree woodland) Alliance

Olneya tesota and *Parkinsonia florida* occur together or on their own and have at least 2% combined cover (in both the shrub and tree layers). Associated species may include *Larrea tridentata* and *Ambrosia salsola*, which may have similar or higher cover to *Olneya tesota* and/or *Parkinsonia florida*. Stands occur east and south of Joshua Tree National Park. They are usually tied to small to large washes and occasionally are spread out over the middle portions of large alluvial fan systems...
4227 = *Parkinsonia florida* – *Olneya tesota* (Blue palo verde-ironwood woodland) Alliance

65'. Stands with the major woody species *Acacia greggii*, *Pluchea sericea*, or *Hyptis emoryi* visually prominent (may be as low as 1% cover), characteristic, and of even distribution. These species are smaller in stature than those in couplet 65. Although the stands may include scattered individuals of those

species characteristic of the previous couplet, they are in insufficient cover or dispersion to be diagnostic (three choices below)...

Pluchea sericea is present in the canopy with >2% absolute cover and no other shrub species having equal or greater cover. Occurs around springs, seeps, irrigation ditches, canyon bottoms, stream sides, and seasonally flooded washes. May include *Baccharis salicifolia, Atriplex, Ericameria nauseosa*, and others. Stands occur abundantly adjacent to the Colorado River Valley in alkaline terraces adjacent to *Prosopis glandulosa, Suaeda moquinii*, and occasionally *Phragmites australis* stands...
4221 = *Pluchea sericea* (Arrow weed thickets) Alliance

Acacia greggii is characteristic, occasionally with as low as 1% cover. No other tall shrub species has greater cover, except *Prunus fasciculata* or *Hyptis emoryi,* which may have equal or slightly greater cover than *Acacia.* Smaller shrubs such as *Larrea tridentata, Ericameria paniculata, Krameria grayii* or *Ambrosia salsola* can have higher cover but no more than twice the cover of *Acacia greggii.* Occurs in washes and arroyos, as well as upland valleys and on bouldery slopes. Proliferates after disturbance, such as flood and fire. Found in the Ord Mountains and as far west as the north slope of Sidewinder Mountain into our study area and near Twentynine Palms…
4226 = *Acacia greggii* (Catclaw acacia thorn scrub) Alliance

Vegetation characterized (≥2%) by *Hyptis emoryi*. Other shrub species are not higher in cover and may include *Acacia greggii, Larrea tridentata***,** and *Sarcostemma hirtellum.* In rocky washes of upper bajadas and low-elevation canyons, only in the eastern portion of the study area north of Joshua Tree NP…
4228 = *Hyptis emoryi* (Desert lavender scrub) Alliance

52'. Stands occur in dry interior portions of the cool temperate zones of continents where precipitation is low but winters are also relatively cold. In this study, stands occur primarily in the Mojave Desert and adjacent desert mountain borderlands and not in the southerly lower elevation portions of the study area such as the Sonoran or Colorado Deserts. Locally it is difficult to differentiate some alliances in this subclass from those in the warm semi-desert subclass because the Mojave Desert is transitional between cool and warm deserts and has great topographic variety. Therefore it is common to encounter stands of the warm and cool deserts (52 and 52') adjacent or even intermixed. Thus, this seemingly large dichotomy in the key is often locally less significant than it appears. Mid- and upper-elevation vegetation characteristic of the Mojave Desert ecoregion can be placed into cool semi-desert subclass based on overarching ecological conditions. This includes such iconic vegetation as the *Yucca brevifolia* and *Yucca schidigera* alliances.

Stands include long-persisting woody species but also commonly include species that colonize readily and rapidly when certain conditions are met. *Ericameria* is a particularly diagnostic genus (except *E. paniculata*). *Atriplex confertifolia* and *A canescens* are both placed in the cool desert subclass even though at the subspecific level, the local expression of this vegetation may occur in warmer parts of the desert…
5000 = COOL SEMI-DESERT SCRUB AND GRASS SUBCLASS

66. Stands with the following, generally short-lived and fast-colonizing shrubs being common and diagnostic: *Atriplex canescens, A. confertifolia, Artemisia tridentata* (various subspecies), *Ericameria cooperi, E. nauseosa, Encelia actoni*, *Gutierrezia microcephala, Ambrosia salsola*, and *Sarcobatus vermiculatus...*

67. Stands are dominated or co-dominated by *Atriplex canescens, A*. *confertifolia* or *Sarcobatus vermiculatus.* They occur in many settings, including in dry lakebeds, low dunes adjacent to them, and in rocky uplands or sandy washes...
5100 = Cool Semi-Desert Alkali-Saline Flats Macrogroup MG093
5110 = Shadscale-saltbush cool semi-desert scrub Group
(three choices below)…

Atriplex canescens characterizes stands, typically with the highest shrub cover, though *Ambrosia salsola* and *Atriplex polycarpa* may have similar or slightly higher cover. Stands may have emergent *Yucca brevifolia*. Prefers sandy substrates, usually stabilized dunes or sand ridges, and also sandy washes surrounded by *Larrea tridentata – Ambrosia dumosa, Yucca brevifolia* or *Yucca schidigera a*lliances. May occur above 1000m (3000ft) elevation in sandy washes in granitic mountains (such as the Sidewinder Mountains). The subspecies *linearis* prefers saltier or more alkaline sand at edges of Coyote Lake, adjacent to *Suaeda moquinii* (downslope) or *Atriplex polycarpa* (upslope). A different but ecologically similar subspecies, *A. canescens* var. *laciniata*, occurs around the low dunes and playa margin at Palen Dry Lake. This taxon appears to be more salt-tolerant and can occur in low numbers adjacent to *Allenrolfea occidentalis* on the playa...
5111 = *Atriplex canescens* (Fourwing saltbush scrub) Alliance

Atriplex confertifolia typically has the highest shrub cover, or co-dominates with *Atriplex spinifera* and/or *Artemisia spinescens* on playa edges (as at Edwards Air Force Base). When co-dominant with *Suaeda* on playas, stands key to *Suaeda.* When mixed with *Stanleya pinnata, Lepidium fremontii,* and *Atriplex lentiformis* var. *parryi,* stands key to the *Atriplex confertifolia* alliance. When associated with pool and swale topography and *Lasthenia* spp. in Antelope Valley key to *A. confertifolia.* Stands may occur in alkaline valleys or playas and in the upper mid-elevation Mojave Desert on rolling hills and slopes. Stands are particularly common in the northern portion of the mapping area on rhyolite, upland alkaline soils or in silty badlands. According to Charlton (in Lichvar et al. 2004), at Edwards Air Force Base, *Atriplex confertifolia* tolerates more saline and finer soils than *A. spinifera* (in areas that have high salt and clay concentrations from hydrological activity at lower elevations)....
5112 = *Atriplex confertifolia* (Shadscale scrub) Alliance

Sarcobatus vermiculatus ≥2%. *Sarcobatus* is the relative dominant and may have S*uaeda moquinii* and *Atriplex confertifolia* or *A. canescens* associated in lesser cover. Only known in study area from small (<1ha) stands in the alkali dunes and flats above the southeast shore of Rodgers Lake, the southwest shore of Rosamond Lake and the southeast margin of Buckhorn Lake. *Sarcobatus* seems to prefer sandy and salty soil just above the more abrupt transition to more alkaline/saline and fine textured lake bed. Locally, stands occur adjacent to *Suaeda* or *A. confertifolia* alliance stands. In one case, the edge of the stand was marked by a sandy ridge covered by an *A. canescens – Yucca brevifolia* stand. Note: formally this alliance is part of the **5500 = Cool Semi-Desert Alkali-Saline Wetlands MG082,** nested within the **5510 = Great Basin cool semi-desert alkali basin Group**. However, ecologically it is associated with *Atriplex confertifolia* and *A. canescens* in the few stands known from this study area...
5511 = *Sarcobatus vermiculatus* (Greasewood scrub) Alliance

67'. Stands characterized by *Encelia actoni, E. virginensis, Ericameria nauseosa, E. cooperi or Gutierrezia,* with *Atriplex canescens, A*. *confertifolia* or *Sarcobatus* being absent or insignificant. Stands have received recent disturbance from fluvial action,

fire, or clearing and are usually in rocky uplands, cobbly washes, or other areas that are not alkaline, playa-like, or particularly sandy...

5200 = Cool Semi-desert wash and disturbance scrub Macrogroup MG095

68. The dominant taxa are relatively small, short-lived plants that colonize uplands following natural or unnatural disturbance such as clearing or fire. Stands are characterized by species such as *Encelia actoni, E. virginensis, Ericameria nauseosa, E. cooperi or Gutierrezia.* Other co-dominant plants that may occur in such settings include *Ambrosia salsolia, Eriogonum fasciculatum,* especially ssp. *polifolium, Ephedra nevadensis, Thamnosma montana*, and *Tetradymia* sp.…

5210 = Intermontane seral shrubland Group

(four choices below)...

Encelia virginensis or *E. actoni,* ≥2% cover. No other shrub species with greater or equal cover. Typically of washes or other disturbed areas (such as recently burned mid elevation desert slopes) throughout the Mojave Desert. In the West Mojave borders of the Transverse and Tehachapi ranges, stands often occur on steep south-facing slopes associated with *Hesperoyucca whipplei* or *Eriogonum fasciculatum*. The biggest stands are upland, steep, south- or southeast-facing slopes near Valyermo or Gramercy Avenue off of Hwy 138 south of Phelan. Small stands occur in washes and on recently burned slopes in the Stoddard Wells and Whitehorse Mountain area and as far east as Ord Mountain. Stands may also have relatively high cover of *Achnatherum speciosum* and *Salazaria mexicana.* (Note: *Encelia actoni* was previously considered a subspecies of *Encelia virginensis.* The two share very similar ecological traits. *E. actoni* is the taxon most common in the study area)…

5211 = *Encelia (actoni, virginensis*) (Acton's encelia and Virgin River brittlebush scrub) Alliance

Ericameria nauseosa typically has ≥2% absolute and ≥25% relative cover. If *E. nauseosa* is co-dominant with *Eriogonum fasciculatum,* key to the *E. fasciculatum* Alliance. Found in mid and upper elevations, usually in areas with fire, flood or agricultural or grazing history. Most mappable stands are in the Antelope Valley to Hesperia and are particularly abundant on the margins of the Liebre, Tehachapi, and Sierra Nevada mountains and also off alkali soils in the Antelope Valley. Several subspecies are included…

5212 = *Ericameria nauseosa* (Rubber rabbitbrush scrub) Alliance

Gutierrezia microcephala or *G. sarothrae* are locally dominant on loose substrates such as gravelly washes, and on steep rocky slopes with unstable substrate. Cover of *Gutierrezia microcephala* or *G. sarothrae* is higher than any other shrub. Other shrubs may include *Grayia spinosa, Salvia mohavense, Ericameria teretifolia,* or *E. cooperi.* Most stands in our area are composed of *G. microcephala,* not *G. sarothrae*...

5214 = *Gutierrezia sarothrae* (Broom snake weed scrub) Provisional Alliance

Ericameria cooperi is evenly distributed and dominant across the stand. Stands show evidence of recent disturbance (typically fire) and are usually adjacent to stands with larger and longer-lived shrubs that are more easily keyed to *Grayia spinosa, Ericameria teretifolia, Coleogyne ramosissima,* or *Larrea tridentata – Ambrosia dumosa*.

This type is highly provisional based on *E. cooperi* having a significant presence (generally >40% relative cover) in a stand. This alliance is unusual

and most stands with co-dominant *E. cooperi* can be better placed in the *Ambrosia dumosa*, *Grayia spinosa*, or *Ambrosia salsola* alliances. Stands co-dominated by *E. nauseosa* or *E. teretifolia* usually key to those alliances, respectively. The species occurs commonly in the West Mojave in all sub-regions. It is spring-flowering and shorter-lived species that is more of a disturbance responder than *Ericameria teretifolia*…
5215 = *Ericameria cooperi* (Cooper's goldenbush) Provisional Alliance

68'. A subspecies of *Artemisia tridentata* is dominant or co-dominant in the shrub canopy. *A. tridentata* (*sensu lato*) ≥2% absolute cover in the shrub canopy. Classification of vegetation using *Artemisia tridentata* has proceeded using different subspecies to indicate alliances due to the ecological stereotypy of many of the races. However, identifying subspecies is difficult because genotypic and phenotypic variation is common. Two different ecologically distinct races are segregated in the classification within the study area:
5300 = Western North America Tall Sage Shrubland and Steppe Macrogroup MG096
5310 = Inter-Mountain West mesic tall sagebrush shrubland and steppe Group…

69. *Artemisia tridentata* ssp. *tridentata* is dominant or co-dominant. No other single shrub species has greater cover except *Ericameria nauseosa, Eriogonum fasciculatum*, or *Eriodictyon trichocalyx.* These stands occur in coarse alluvium (granitic sands and gravels) of valleys on the north side of the San Gabriel and Sierra Pelona ranges. Stands with co-dominance of *Prunus fasciculata* key to *Prunus*. Stands with >2% cover of *Juniperus californica* or *Yucca brevifolia* (regardless of height) key to *Juniperus* or *Yucca*, respectively...
5311 = *Artemisia tridentata* (Big sagebrush) Alliance

69'. *Artemisia tridentata* ssp*. parishii* is dominant or co-dominant. No other single shrub species with greater cover, except *Ericameria nauseosa, Eriodictyon trichocalyx, Atriplex polycarpa, A. canescens, A. confertifolia*, or *A. spinifera*. Those species may be no more than 60% relative cover as long as *A. tridentata* ssp. *parishii* has at least 30% relative cover and is evenly distributed. *Atriplex tridentata* ssp. *parishii* occurs on finer textured soils, more immediately adjacent to swales or intermittent channels than typical stands of *A. tridentata* ssp. *tridentata*. *Atriplex tridentata* ssp. *parishii* is largely restricted to silty alluvial sediments of the west Mojave and adjacent Transverse Ranges and appears relatively tolerant of alkalinity. Stands occur adjacent to stands of *Atriplex spinifera, A. polycarpa* and *A. confertifolia, Prosopis, Larrea tridentata – Ambrosia dumosa* and other core Mojave Desert Alliances. They may also occur immediately adjacent to wetlands (*Juncus arcticus, Distichlis spicata*) and riparian (*Populus fremontii, Forestiera pubescens*) stands. [Note: this can also be keyed in desert xero-riparian group of this key (at couplet 64')]...
4217 = *Artemisia tridentata* ssp*. parishii* Provisional Alliance

66'. Vegetation is usually characterized by scrubs of the cooler (higher elevation) desert. Most diagnostic species are long-lived. Some resprout following fire, but some are extremely sensitive to fire (especially *Coleogyne*). Although widespread in the higher elevations of the Mojave Desert, in many areas of the western and central Mojave and Sonoran desert, fires and clearing have resulted in a complex of transitional types that intergrade between seral scrub alliance stands and more stable persistent stands. *Larrea tridentata, Encelia farinosa,* and for the most part *Ambrosia dumosa* are not present as major alliance indicators. Indicator species include: *Coleogyne ramosissima, Ericameria*

teretifolia, Grayia spinosa, Krascheninnikovia lanata, Ephedra nevadensis, E. viridis, Eriogonum fasciculatum, Lycium andersonii, L. cooperi, Purshia tridentata, Salazaria mexicana, Yucca brevifolia and *Yucca schidigera*…
5400 = Inter-Mountain Dry Shrubland and Grassland Macrogroup MG098

70. Stands with the following species as diagnostics: *Grayia spinosa, Krascheninnikovia lanata, Ephedra nevadensis, E. viridis, Eriogonum fasciculatum, Lycium andersonii, L. cooperi,* and *Salazaria mexicana.* These vegetation types merge with the upper edge of the *Larrea tridentata – Ambrosia dumosa* belt and are usually seen on north-facing slopes at lower elevations, but also occupy basins and slopes at all elevations above 1050m (3500ft). While they may occur on slopes, they are also found on medium textured soils of basin margins and lower fans, especially in cool air drainages. This group includes many similar vegetation types with subtle distinction between them based on soil texture, chemistry and disturbance regime. Most types recover rapidly following fire compared to the Mojave and Great Basin Upper Bajada and Toeslope Group. [Note: *Eriogonum fasciculatum* (esp. *E.* ssp *polifolium*) is a common associate in this group, especially on rocky uplands. If *Eriogonum fasciculatum* is a dominant with any of the following alliance-level indicators present, key to *Eriogonum fasciculatum* (desert version), if lower in cover than any other shrub, key to another appropriate alliance based on rules in categories in the following alliances]...
5410 = Intermontane deep or well-drained soil scrub Group

71. Stands are dominated or characterized by resprouting members of the genus *Ephedra* (two choices below)…

Ephedra nevadensis >2% cover. No other species with greater cover with the exceptions of *Acamptopappus sphaerocephalus* or *Chrysothamnus viscidiflorus*. Stands in this study occur in two basic situations: (1) cooler mid- or upper slopes of mountains where *Salazaria, Encelia actoni* and *Ericameria cooperi* are co-dominant, often replacing *Grayia spinosa* or *Coleogyne ramosissima* following repeated fire; or (2) broad terraces adjacent to large washes (e.g., Little Rock Wash, Rock Creek Wash) between Pearblossom and Palmdale, often co-dominant with *Encelia actoni* and containing emergent *Yucca brevifolia.* Both expressions are often adjacent *to Larrea tridentata-Ambrosia dumosa* stands (upper elevation associations of *Larrea tridentata-Ambrosia dumosa* often contain *E. nevadensis*). Fire stimulates resprouting in *E. nevadensis,* as does occasional fluvial disturbance. *Ephedra nevadensis* stands are difficult to predict because of their dependence upon fire or fluvial disturbance. Rocky substrates, either cobble-alluvium or shallow broken colluvium on slopes are usually important. Stands are not found on extensive sandy or fine-textured soils.

Stands often mix with other mid-elevation scrub species such as *Grayia*, *Salazaria mexicana, Tetradymia* spp., *Ericameria cooperi, Eriogonum fasciculatum,* or (near Twentynine Palms), *Viguiera parishii* and *Simmondsia chinensis. Achnatherum speciosum* is common in many stands. *Coleogyne ramosissima* and *Ephedra nevadensis* often occur in similar situations and exposures, but *Coleogyne* is killed outright by fire, while *E. nevadensis* is stimulated by it. Thus, *E. nevadensis* may in some cases be a type conversion from *Coleogyne* in many burned areas of the desert mountains. If *Eriogonum fasciculatum* is co-dominant with *E. nevadensis,* the stand would key to *Eriogonum fasciculatum* (desert version)...
5413 = *Ephedra nevadensis* (Nevada jointfir) Alliance

Ephedra viridis ≥2% cover (rarely 1% in stands with sparse total canopy cover) and dominant or co-dominant with other shrubs. In our area, *Ephedra viridis* is dominant or co-dominant with *Ericameria teretifolia, Grayia spinosa*, *Salazaria mexicana, Krascheninnikovia lanata, Ericameria cuneatus*, or *Eriogonum fasciculatum*. Found on steep, boulder-covered slopes of mid-elevation to higher mountains in the study area, from the Scodie Mountains west of the California Aqueduct, to the highest points of the Ord Mountains (>1800m, 5900ft). Associated with steep talus or rock outcrops except at the highest elevations, when it can occur on more moderate slopes. Tends to mix with *Grayia spinosa*, *Salazaria mexicana* or with *Ericameria teretifolia* in slightly lower and warmer, rocky settings. Also may mix with *Brickellia desertorum* on slopes of the Sidewinder or Granite mountains (near Apple Valley)…
5417 = *Ephedra viridis* (Mormon tea scrub) Alliance

71'. Stands not characterized by *Ephedra* (though it may be present in lesser numbers than other shrub species)…

72. Stands characterized by the dominance of a species of *Lycium* (two choices below)...

Lycium andersonii is strongly dominant without high cover of other alliance indicators such as *Salazaria, Grayia, Ephedra nevadensis,* or *Eriogonum fasciculatum.* Rarely mappable and poorly defined in the western Mojave, although a common widespread shrub of many mid- and upper-elevation scrubs of the Mojave and southern Great Basin. Stands are rare in our study area and usually small in extent. Small stands have been noted in several situations from low granitic rock outcrops, to rocky uplands above *Grayia* stands in cold air drainages and basins. This type is closely ecologically related to several other alliances, *(Grayia spinosa, Larrea tridentata – Ambrosia dumosa, Yucca schidigera).* This type is not described in Thomas et al. (2004), but is discussed in Barbour et al. (2007). Beatley (1976) discusses its relationship to *Atriplex confertifolia* and *Grayia spinosa* in the Nevada test site...
5414 = *Lycium andersonii* (Anderson's boxthorn scrub) Alliance (not mapped and not inventoried in study area)

Lycium cooperi is dominant and evenly distributed across the stand or it is co-dominant with *Ambrosia salsola*. If *Grayia spinosa, Krascheninnikovia lanata* or shrubby *Atriplex* species are co-dominant, stands key to those alliances, respectively. Occasional stands exist at the margins of alkaline or saline basins, or on terraces above washes where soils are moderately fine-textured. *Lycium cooperi* increases following fires relative to more weakly sprouting or non-sprouting species such as *Larrea tridentata, Ambrosia dumosa,* and *Atriplex* spp. When co-dominant with *Salazaria, Atriplex canescens*, or *Prunus fasciculata*, as in washes and arroyos, key to those alliances…
5418 = *Lycium cooperi* (Cooper's boxthorn scrub) Provisional Alliance

72'. Stands not characterized by the dominance of *Lycium*…

73. Stands with *Grayia spinosa* or *Krascheninnikovia lanata* characteristic, either co-dominant with other shrubs or dominant (two choices below)…

Grayia spinosa usually ≥2% absolute cover (rarely <2% in stands with a very sparse total shrub cover), evenly distributed, and no other species with substantially greater cover. Co-dominance is the rule with *G spinosa* stands; they rarely are strongly monospecifically dominant. Thus, careful assessment of shrub dispersion is important for proper identification. In many cases stands have been affected by fire, clearing, grazing, or other disturbances and seral shrubs or increasers like *Tetradymia stenolepis*, *Ericameria cooperi, Lycium cooperi, Lepidium fremontii, Senna armata*, or *Lycium andersonii* can have similar cover. *Grayia spinosa* alliance stands occupy the transition between warm desert and cool desert vegetation in much of the study area. *Grayia spinosa* does re-sprout after fire, and along with *Salazaria, Encelia actoni,* and *Lycium andersonii,* may replace *Coleogyne ramosissima* stands as a result. There are many post-fire seral stands that have strong mixtures of multiple species, but if *G. spinosa* is evenly distributed in such stands they key to *G. spinosa.* If *Ephedra viridis* is present at ≥2% cover and evenly distributed, please see *E. viridis* alliance.

At lower elevations, *Grayia* stands usually occur on north-facing slopes in regions dominated by *Larrea tridentata – Ambrosia dumosa*, in lower basins and cold-air drainages on relatively well-drained medium-textured soils. Larger stands occur on moderate to gentle mid- and upper-slopes above approximately 1000m (3000ft) or on basin margins in a "bathtub ring" above *Atriplex polycarpa* or *A. spinifera* stands. At similar elevation to *Coleogyne ramosissima*, *Grayia* stands are on relatively less rocky and less exposed sites (mid-slope, not convex upper-slope) and often have evidence or more recent fire. Stands transition to *Ambrosia dumosa* adjacent to *Larrea tridentata – Ambrosia dumosa* on lower slopes, and to *Ericameria teretifolia* or *Ephedra nevadensis* on convex rocky slopes, or *Salazaria mexicana* on concave (often burned) rocky slopes, or *Ephedra viridis* on higher elevation rocky crags or slopes. Abrupt shifts in soil texture in flats and basins give way to *Atriplex spinifera* or *A. polycarpa* on fine textured soils, or to *Krascheninnikovia lanata* on calcareous soils, or to *Ambrosia dumosa* or *Larrea tridentata – Ambrosia dumosa* on well-drained slopes above cold air pockets...

5411 = *Grayia spinosa* (Spiny hop sage scrub) Alliance

Vegetation usually of mid- to upper-elevation flats and small basins dominated strongly by the low shrub *Krascheninnikovia lanata*, without any other species in higher cover. Stands occur in small basins with silty, but not strongly alkaline soil, southeast of California City, where *Atriplex spinifera* is not dominant. These stands give way to *Grayia*, then *Ambrosia dumosa*, and then *Larrea tridentata – Ambrosia dumosa* in sequence as one moves up-slope. The largest stands occur in Superior Valley, in matrices adjacent to *Atriplex spinifera* on calcium rich soils (with a whitish caliche layer at surface), or *Atriplex confertifolia* on saltier basin soils, or *Ambrosia dumosa* on slightly higher slopes with better drained soils. *Krascheninnikovia lanata* also occurs on altered calcareous soils adjacent to volcanics on northwest slopes and eastern slopes of the El Paso Mountains - specifically on shallow caliche and high pH rocks (e.g., rhyolite, dolomite) where stands tend to co-dominate with

Grayia and *Tetradymia axillaris.* Stands have been assumed rare throughout the California deserts, but some extensive stands have been mapped in this study. These include the largest ones now known from California...
5412 = *Krascheninnikovia lanata* (Winterfat scrubland) Alliance

73'. Stands neither with *Grayia* or *Krascheninnikovia lanata* as conspicuous or dominant…

74. Stands with *Ericameria teretifolia* ≥2% absolute cover (rarely <2% cover in stands with a very sparse shrub layer). *Ericameria teretifolia* typically has the highest cover, but may share dominance with *Eriogonum fasciculatum, Gutierrezia sarothrae*, or *Opuntia chlorotica*. Found in disturbed uplands in the mid-elevation Mojave or Sonoran Desert, but also occurs in longer-persistent stands on shallow granitic pediments and rock outcrops. *Ericameria teretifolia* is the dominant or co-dominant shrub and may occupy shallow rocky post- fire stands associated with *Juniperus californica* or other upland alliances. In our area it is usually found in low cover shrublands, on granitic or other rocky uplands on south- or north-facing steep, bouldery slopes, and is more warm-tolerant than *Ephedra viridis* and thus usually at lower elevations. When co-dominant with *Grayia, Ephedra viridis, Coleogyne,* or *Salazaria*, key to those alliances…
5416 = *Ericameria teretifolia* (Needleleaf rabbitbrush scrub) Alliance

74'. Stands with *E. teretifolia* absent or in low relative cover. Instead, stands are dominated or co-dominated by *Eriogonum fasciculatum* or *Salazaria mexicana* (two choices below)...

Eriogonum fasciculatum ≥2% absolute cover (rarely <2% cover in stands with a very sparse shrub layer) or >50% relative cover in the shrub canopy; other shrubs if present usually less than half its cover, but *Hyptis emoryi* or *Salvia dorrii* may be higher (Thomas et al. 2004) and *Ephedra nevadensis*, *Ericameria nauseosa,* or *Ambrosia salsola* can be broadly co-dominant with *Eriogonum fasciculatum*. Mixed stands with *Ericameria cooperi* or *Grayia spinosa* and other mid-elevation shrubs only require *Eriogonum fasciculatum* to have higher cover and be more evenly distributed than any of the other shrubs. Most pure stands occur along the east face of the Tehachapi and Scodie Mountains. These stands and those in the Cajon Pass area that are surrounded by chaparral tend to have substantially higher shrub cover and usually do not co-dominate with many species, instead they are often single dominant stands. In the desert hills and mountains >1000m (3000ft) elevation, *Eriogonum fasciculatum* co-occurs with many other semi-desert shrubs; if *Encelia actoni, Ericameria teretifolia, Purshia tridentata* or *Ericameria linearifolia* are equal or higher cover, then go with those alliances....
2221 = *Eriogonum fasciculatum* (California buckwheat scrub) Alliance

Salazaria mexicana ≥2% cover. Other shrubs, if present, are in lower cover, with the exceptions of *Ambrosia salsola, Eriogonum*

fasciculatum, Hyptis emoryi, Senna armata or Salvia dorrii, which may have higher or similar cover. *Salazaria* stands are mostly restricted to sandy or gravelly washes in terrain where fire has been minimal, but may occur on burns or in other disturbed uplands throughout steep and rocky uplands. Substrate for all expressions of this alliance is frequently granitic or crystalline non-calcareous metamorphic (gneiss, schist, phyllite). In washes, *S. mexicana* often commonly occurs with *Ambrosia salsola, Bebbia juncea, Eriogonum fasciculatum* or *Senna armata.* On rocky slopes, it tends to occupy bases of larger outcrops or narrow concave defiles, or ravines where water is channeled during run-off. Depending upon the site topography, many upland *Salazaria* polygons may actually contain a fine-scale matrix of several vegetation alliances including *Encelia actoni, Ephedra nevadensis, Eriogonum fasciculatum, Ambrosia salsola* or *Ericameria teretifolia.* In such instances, the overall expression of burned rocky uplands with a number of concavities or concentrations of vegetation at the base of rock outcrops tends to emphasize the balance of overall cover toward *Salazaria*, even though other small stands may be present...
5415 = *Salazaria mexicana* (Bladder sage scrub)

70'. Stands with other shrub or herbaceous species as diagnostics...

75. Shrubs form the dominant layer (at least 2% and evenly distributed). If present, *Grayia spinosa, Krascheninnikovia lanata, Ephedra nevadensis, E. viridis, Eriogonum fasciculatum, Lycium andersonii, L. cooperi, Salazaria mexicana* are usually less conspicuous or subordinate to species in the genera *Coleogyne, Purshia, Menodora, Cercocarpus,* or *Yucca*...
5420 = Mojave and Great Basin upper bajada and toeslope Group

76. *Coleogyne ramosissima* is the dominant or co-dominant shrub, typically with no species of *Yucca, Juniperus,* or taller shrub greater than 33% of the total relative cover of *Coleogyne*, though other smaller shrubs such as *Ephedra nevadensis* may have similar cover. If *Yucca schidigera* is present, it only needs to be >1% absolute cover and evenly distributed to shift into a *Yucca schidigera* alliance. If *Coleogyne* is >3 x *Yucca schidigera,* then it is a *Coleogyne* stand. *Coleogyne* typically dominates stands, but may be exceeded in cover by a species of disturbance (*Ambrosia salsola, Salazaria mexicana, Ericameria* spp. or *Eriogonum fasciculatum*). A widespread type on shallow rocky soils on upper bajadas, pediments and hill slopes; generally upslope from *Larrea tridentata – Ambrosia dumosa,* on shallower soils of old alluvium or shallow rocky pediments. Does not prefer steep colluvial deposits with larger rocks and boulders. It is extremely susceptible to even low-intensity fire and many thousands of acres of *Coleogyne ramosissima* are now converted to *Grayia, Salazaria, Ericameria,* and *Ambrosia* types throughout the mapping area. The Stoddard Wells, Fairview Valley, and Ord Mountain areas are particularly devastated by fires...
5421 = *Coleogyne ramosissima* (Black brush scrub) Alliance

76'. *Coleogyne* is not important. Instead, *Yucca, Purshia, Cercocarpus* or *Menodora* is conspicuous and/or dominant…

77. A *Yucca* species is conspicuous and evenly distributed (two choices below)...

Yucca brevifolia present and evenly distributed throughout the stand, though usually only between 1 and 5% cover (cover may be as high as 10% in clonal stands in the western part of the mapping area). Stands often have substantially higher cover of shorter shrubs or perennial grasses beneath the well-spaced emergent trees. *Yucca brevifolia* must be evenly distributed, not scattered and clumped, and must be 1% or greater absolute cover to map at the alliance level. It is usually difficult to discern juvenile *Yucca brevifolia* <3m tall, so these are not always accounted for in mapping. If *Juniperus californica* is present, *Yucca brevifolia* must be >2 x the cover of *Juniperus. Pinus monophylla* must be lower than 1% absolute cover and not evenly distributed. If sclerophyll shrubs such as *Fremontodendron* or *Quercus john-tuckeri* are present, these are less than 10% absolute cover...
5423 = *Yucca brevifolia* (Joshua tree woodland) Alliance

Yucca schidigera is conspicuous, evenly distributed and generally ≥2% absolute cover; however, since sub-meter imagery has been used and signatures are generally recognizable at low covers, *Y. schidigera* has been pulled out as low as closer to 1% absolute cover as long as it is evenly distributed. At lower elevations, stands may have *Larrea tridentata, Ambrosia dumosa*, and other shrubs at equal or even higher cover. *Yucca brevifolia* is often scattered in the tree layer (<1%). At upper elevations, *Juniperus californica* may be present (<2% cover). If *Juniperus* is ≥2x the cover of *Yucca schidigera*, then key to the *Juniperus californica* Woodland Alliance. If *Coleogyne ramosissima* is conspicuous, *Yucca schidigera* must have ≥2% cover. Found on pediments and hillslopes near the upper-elevation range of the alliance, and common on bajadas and moderate to gentle hillslopes at mid-elevations. Occurs predominantly in the southeast portion of the study area, including the Ord Mountains, Stoddard Wells, and Fairview Valley...
5424 = *Yucca schidigera* (Mojave yucca scrub)

77'. *Yucca* is not important and not evenly distributed. Instead, either *Cercocarpus, Purshia, or Menodora* are conspicuous, dominant, or co-dominant (three choices below)...

Purshia tridentata has ≥2% absolute cover and often has higher relative cover than any other single shrub (but see exceptions below). If *Artemisia tridentata* or *Ephedra viridis* are present they have ≤1% cover. Stands are locally represented adjacent to the San Bernardino, San Gabriel and southern Sierra Nevada Mountains. Confusion between this alliance and *Eriogonum fasciculatum*, *Encelia actoni,* and *Ericameria linearifolia* alliance stands occurs on the north slopes of the San Bernardino Mountains south of Lucerne Valley; all stands with evenly distributed co-dominant to dominant *P. tridentata* are keyed to *P. tridentata.* Stands in the current study area are often the result of burned *Juniperus californica* stands that have resprouting *Purshia*. Exceptions include steep rocky slopes near Cushionberry Grade and steep incised faces of old alluvial surfaces at the base of the San Gabriel Mountains near Valyermo, where stands are co-dominant with *Eriogonum fasciculatum, Encelia actoni, Ephedra nevadensis,* and *Hesperoyucca whipplei*...
5422 = *Purshia tridentata* (Bitter brush scrub) Alliance

Menodora spinescens with ≥2% cover and no other single species with greater cover, although many other species may be present. Represented by a few localized stands in well-defined, shallow rocky soils, characteristically just above *Larrea tridentata – Ambrosia dumosa*. Locally restricted to pale limestone (or possibly dolomite) outcrops associated with pediments north of Ord Mountain...
5425 = *Menodora spinescens* (Greenfire scrub) Alliance

Vegetation characterized by the relative dominance of the shrubby tree *Cercocarpus ledifolius,* which must be at least 2% cover and evenly distributed. No other large shrub or tall tree has similar or greater cover than *C. ledifolius*. Stands occur in dry, rocky, and usually very well-drained exposures in the highest portions of the Inyo, Panamint, and other tall ranges of the northern Mojave Desert - but currently only known to occur adjacent to *Coleogyne* on limestone, on the north slope of the San Bernardino Mountains in the study area. These low elevation stands (1400m, 4600ft) may very well be the only stands in the study area...
5441 = *Cercocarpus ledifolius* (Curl leaf mountain mahogany scrub) Alliance (formally within the 5440 = Intermountain shallow/calcareous soil scrub Group)

75'. Shrubs are not evenly distributed and perennial grasses comprise the dominant layer (three choices below)…
5430 = Southern Great Basin semi-desert grassland Group

Achnatherum speciosum is dominant, with no shrubs comprising more than 10% relative cover and none evenly distributed across the stand. Stands are the result of fire eliminating desert shrub cover from stands that were formerly *Coleogyne ramosissima*, *Larrea tridentata – Ambrosia dumosa*, *Atriplex canescens*, etc. The largest stands noted occur in the western Antelope Valley and Superior Valley. Persistence is unknown, but stands probably develop shrub dominance in <50 years, without fire or other disturbance...
5431 = *Achnatherum speciosum* (Desert needlegrass grassland) Alliance

Pleuraphis jamesii comprises >2% cover with no other perennial grasses or shrub species present in greater cover. Stands are restricted to below minimum map unit size, except perhaps on parts of the upper slopes of Ord Mountain, Stoddard Mountain, Sidewinder Mountain and other peaks ≥1500m (4500ft), in the central or northern portions of our study area that receive some reliable summer precipitation. They occur on rocky, gentle to moderately steep slopes, in some cases adjacent to unstable scree or talus. The small (often <1 acre) stands are often associated with *Grayia, Ephedra viridis, Gutierrezia microcephala* and *Opuntia eriantha*. Fire on the top of Ord Mountain has probably enhanced the species extent, but most individuals are associated with sufficient shrub cover to be considered understory herbs in a shrub alliance, rather than the dominant species in a predominantly herbaceous canopy...
5432 = *Pleuraphis jamesii* (James' galleta shrub-steppe) Alliance (not mapped and not inventoried in study area)

Achnatherum hymenoides is dominant; cover is usually <10% and stands transition to *Larrea tridentata* or *Larrea tridentata – Ambrosia dumosa* when shrubs become evenly distributed at >2% cover. Small stands are widely

scattered throughout the mapping area on dune aprons and other sandy soils. The most extensive stands seen were in the area east of Lucerne Lake and north of Old Woman Springs, but other smaller stands exist well westward. Stands that have <2% *Achnatherum hymenoides* and >2% *Abronia* or *Dicoria* would key to the *Dicoria canescens – Abronia villosa* Alliance (6121*)...*

5433 = *Achnatherum hymenoides* (Indian rice grass grassland) Alliance

Appendix D

Crosswalk to Names in the Jepson Manual, 2nd edition (Baldwin *et al.* 2012)

Name in this report	Name in The Jepson Manual, 2nd ed.
Acacia greggii	*Senegalia greggii*
Achnatherum hymenoides	*Stipa hymenoides*
Achnatherum speciosum	*Stipa speciosa*
Atriplex phyllostegia	*Atriplex covillei*
Baccharis emoryi	*Baccharis salicina*
Bromus rubens	*Bromus madritensis* ssp. *rubens*
Bromus trinii	*Bromus arizonicus*
Camissonia claviformis	*Chylismia claviformis*
Coreopsis calliopsidea	*Leptosyne calliopsidea*
Isomeris arborea	*Peritoma arborea*
Leymus triticoides	*Elymus triticoides*
Lolium perenne	*Festuca perennis*
Lotus rigidus	*Acmispon rigidus*
Lotus scoparius	*Acmispon glaber*
Nassella cernua	*Stipa cernua*
Nassella pulchra	*Stipa pulchra*
Opuntia erinacea	*Opuntia polyacantha* var. *erinacea*
Pleuraphis jamesii	*Hilaria jamesii*
Pleuraphis rigida	*Hilaria rigida*
Rhus trilobata	*Rhus aromatica*
Salazaria mexicana	*Scutellaria mexicana*
Sarcostemma hirtellum	*Funastrum hirtellum*
Suaeda moquinii	*Suaeda nigra*
Tidestromia oblongifolia	*Tidestromia suffruticosa* var. *oblongifolia*
Viguiera parishii	*Bahiopsis parishii*
Vulpia microstachys	*Festuca microstachys*

Appendix E

Field Reconnaissance Form

RECON FIELD FORM (May 17, 2011)

Date:	**Surveyors (circle recorder):**
Waypoint ID: **UID:**	**GPSname: Projected? Yes / No / Base** If yes, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____(meters)** Base UTMs / projected UTMs (circle one) UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ PDOP: +/- Elev.(m)

Size of stand (acres): <1 1-10 >10 Camera/Photos:

Field alliance name:

Comments:

% Cover - Conifer Tree: Hardwood tree: Joshua Tree: Tree: Shrub: Herb:

Strata	Species	% cover		Strata	Species	% cover		Strata	Species	% cover

Date:	**Surveyors (circle recorder):**
Waypoint ID: **UID:**	**GPSname: Projected? Yes / No / Base** If yes, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____(meters)** Base UTMs / projected UTMs (circle one) UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ PDOP: +/- Elev.(m)

Size of stand (acres): <1 1-10 >10 Camera/Photos:

Field alliance name:

Comments:

% Cover - Conifer Tree: Hardwood tree: Joshua Tree: Tree: Shrub: Herb:

Strata	Species	% cover		Strata	Species	% cover		Strata	Species	% cover

Date:	**Surveyors (circle recorder):**
Waypoint ID: **UID:**	**GPSname: Projected? Yes / No / Base** If yes, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____(meters)** Base UTMs / projected UTMs (circle one) UTME ___ ___ ___ ___ ___ ___ UTMN ___ ___ ___ ___ ___ ___ ___ PDOP: +/- Elev.(m)

Size of stand (acres): <1 1-10 >10 Camera/Photos:

Field alliance name:

Comments:

% Cover - Conifer Tree: Hardwood tree: Joshua Tree: Tree: Shrub: Herb:

Strata	Species	% cover		Strata	Species	% cover		Strata	Species	% cover

Appendix F

Field Verification Form and Protocol

Field Verification Form: DRECP Vegetation Mapping (9/24/2012)

Surveyors (circle recorder)**:**	**Date:**

Waypoint ID:	**GPSname: Projected? Yes / No / Base / Digitized** If projected or digitized, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____ (meters)**
Polygon UID:	Base UTMs / projected UTMs (circle one) Elev.(m): UTME __ __ __ __ __ __ __ __ __ UTMN __ __ __ __ __ __ __ __ __ PDOP: +/-

Strata	Species	% cover		Strata	Species	% cover		Strata	Species	% cover

Notes: (including recommendations for line-work revision, state of veg. "discernability" based on season and topography, classification interpretation, homogeneity and unusual sightings of plants or animals)	
USGS Quad Name	
Map Unit (code and name)	
Camera/Photos	
Conifer Cover	None >0-1% >1-5% >5-15% >15-25% >25-50% >50-75% >75-100% NA
Hardwood Cover	None >0-1% >1-5% >5-15% >15-25% >25-50% >50-75% >75-100% NA
Joshua Tree Cover	None >0-1% >1-5% >5-15% >15-25% >25-50% >50-75% >75-100% NA
Total Tree Cover	None >0-1% >1-5% >5-15% >15-25% >25-50% >50-75% >75-100% NA
Shrub Cover	None >0-1% >1-5% >5-15% >15-25% >25-50% >50-75% >75-100% NA
Herb Cover	0-2% >2-15% >15-40% >40% NA
Exotics	None or not visible 1 2 3 Not Applicable
Development	None or not visible 1 2 3 Not Applicable
Anthropogenic Alteration	None or not visible 1 2 3 Not Applicable
Hydrologic Modification	NO YES Not Applicable
Estimated area of identifiable vegetation viewed	Radius (m) _____ or rough % of polygon viewed from point _____
Is this a "multiple" point assessment?	NO YES if yes: _____ of ____ points for this polygon

CALIFORNIA NATIVE PLANT SOCIETY / DEPARTMENT OF FISH AND GAME PROTOCOL FOR FIELD VERIFICATION SAMPLING USING FIELD VERIFICATION FIELD FORM

(Modified for DRECP)

This protocol describes the methodology for Field Verification (FV) sampling as recorded on Field Verification field survey form dated September 24, 2012. The FV sample protocol is similar to the CNPS Rapid Assessment Protocol, but omits description of the physical environment: geology, soils, slope and aspect.[1]

Field Verification (FV) is a measurement of how closely mapped vegetation matches vegetation on the ground.[2] Samples are taken to test locational accuracy (*i.e.,* if the lines are positioned correctly) and classification accuracy (i.e., if the vegetation has been correctly identified. To conduct FV, sampling crews (typically two persons per crew) collect vegetation data on a subset of the mapped vegetation polygons. These polygons have been allocated to represent all of the vegetation types that have been mapped for the project, or for part of a large project. Before beginning FV, crew members should become familiar with the plant species and the landscape positions these plants typically occupy within the project and the vegetation types identified and/or the vegetation classification developed for the project.

Surveyors are provided with a set of polygons to sample. Usually the polygons are pre-loaded in the crews' Global Positioning System (GPS) units as well as printed on paper maps. Surveyors receive only the shapes of the polygons they are to sample; no attributes and no adjacent polygons are provided.

Having navigated to the allocated polygon, FV samplers list the dominant species observed and the stratum (tree, shrub, herb) in which they occur to characterize the stand or stands of vegetation present, remembering that a stand is the basic physical unit of vegetation in a landscape. It has no set size but is defined by two main unifying characteristics: compositional integrity and structural integrity, together termed homogeneity.

For Field Verification, surveyors will collect data based on the entire polygon. If the mapped polygon actually includes > 1 vegetation type, or if the stand observed exceeds the polygon as mapped, FV samplers are to describe these discrepancies in the "Notes" section of the form.

Surveyors typically take a GPS point and describe the vegetation in the polygon from one location. However, if the polygon is very large or contains more than one vegetation type of > mmu, two or more FV points should be taken in the same polygon and described on separate datasheets.

Fields on the Form; definitions and instructions

Name(s) of 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 should be recorded. The person recording the data on the form should circle her name/initials.

Date: Date of the sampling.

GPS waypoint #: The waypoint number as assigned by the GPS unit when marking and storing a waypoint for the sample location.

Polygon UID:
The Unique Identity of a polygon as assigned during the mapping or allocation process.

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

UTM coordinates: Easting (UTME) and northing (UTMN) location coordinates using the Universal Transverse Mercator (UTM) grid given by the GPS.

Elev. (m): The elevation in meters as given by the GPS.

PDOP: ± Positional dilution of precision: Record the pdop when taking the UTM field reading. It is a measure of the accuracy of the GPS location. If your GPS does not determine error, insert N/A in this field.

Is 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, or circle "No" if the waypoint was taken at a distance from the stand (such as with a binocular view of the stand).

If No, cite from waypoint to stand, distance (note in meters) & bearing (note in degrees): Record the distance from a rangefinder and the bearing from a compass from the GPS waypoint to the stand. Project into a representative point well within the polygon and describe the placement of the bearing in the Notes section described below.

Dominant Plant Species: Record the estimated % absolute cover of the plant species covering the most area within the sample polygon. Use exact percent coverage if possible: Record a specific number for the total aerial cover or "bird's-eye view" looking from above for each of these species, estimating cover for the living plants only. The porosity of the vegetation should be taken into consideration when estimating percent cover (how much of the sky could you see when you are standing under the canopy of the species). Record the stratum in which each of these taxa occurs using T= tree, S=shrub, H= herb.

Notes: Discuss discrepancies between the vegetation polygon and the vegetation as it appears on the ground. For this project, Minimum Mapping Units are 1 acre for wetlands and certain wash types, 2.5 acres for areas characterized as human land use, and 10 acres for all other polygons.

Given these MMU rules, is there more than one vegetation type large enough to map within the mapped polygon? In other words, should the polygon be split? Alternatively, does the vegetation stand extend beyond the polygon as mapped, requiring re-examination of the boundary of the sample polygon with neighboring polygons?

Are there topographic features that limit your view of the polygon on the ground? Describe the location within the polygon of any bearing point you projected. Based on seasonality and topography, can the vegetation stand(s) be discerned? Are there unique features, such as cliffs, that would not be easily visible from aerial or satellite images? Information in this field may be the most important for truly understanding the vegetation of the polygon, so be as descriptive as possible. Additionally, note any unusual plant or animal sightings.

USGS Quad Name: self-explanatory

Map Unit (code and name): Field call of alliance or map unit. Please use scientific nomenclature, *e.g., Yucca brevifolia* Alliance or 5243 is how a Joshua tree stand would be indicated. Base this call on the vegetation as you observe it, following the classification key. Samplers don't need to deliberate about this too long. If undecided between one or more types, list the first choice in this field and the second choice in the notes field. A final call will be made in the office by staff members who developed the project vegetation classification.

Photograph #s: Write the name or initials of the camera owner, JPG/frame number, and direction of photos. Take four photos in the main cardinal directions (N, E, S, W) clockwise from the north, from the GPS location. If additional photos are taken in other directions, please note this information on the form.

Estimate the cover class of Conifers, Hardwoods, and Joshua Trees:
Using the modified Braun-Blanquet cover-abundance scale (<1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%), record the estimated cover of each tree group separately. The porosity of the vegetation should be taken into consideration when estimating percent cover (how much of the sky can you see when you are standing under the canopy of a tree, or how much light passes through the canopy).

Total Tree Cover: The total foliar cover (considering porosity) of all live tree species, disregarding overlap of individual trees.

Please note: These cover values should not include the coverage of regenerating tree species (i.e., tree seedlings and saplings).

Shrub Cover: The total foliar cover (considering porosity) of all live shrub species disregarding overlap of individual shrubs.

Herb Cover: The total cover (considering porosity) of all herbaceous species, disregarding overlap of individual herbs. Please note herb cover classes differ from those of trees and shrubs.

Exotics: Level of impact by exotic invasive species, broken into the following classes:

Code	Range	notes
	no evidence of exotics visible	
1	patches of exotics visible, but cover not significant (relative cover to total <33%)	
2	exotics (particularly herbaceous) significant and cover may exceed dominant vegetation strata (relative cover <66%)	
3	stand characterized by exotics (vegetation type is "exotic") (relative cover >66%)	
	NA	Exotics is not applicable when the MapUnit is 9300, 9310, 9320, 9800, 9801, 9803, 9804, 9805.

Development: Level of impact by structures (buildings, tanks, paved parking lots, trailers, utility and mining structures) This is for areas where low mmu settlement cannot be pulled out, or the development does not meet the criteria of a settlement. NOTE: This attribute also includes anthropogenic debris (junked vehicles, major trash dumping, collapsed structures, etc.).

Code	Range	Example
	none visible	There are no noticeable junk piles, isolated homes or structures within polygon.
1	low: less than 2% of polygon affected	Junk piles, structures, cement pads, etc. are widely spaced at very low density.
2	moderate: between 3%- 5%of the polygon affected	Multiple examples of dispersed junk, houses, other structures are visible throughout the polygon. There may be a dense concentration of development within a single or few parts of a vegetation polygon, but no developed concentration larger than 2.5 acres (the minimum threshold for pulling out a single "settlement" or 9300 polygon).
3	high: > 5% of polygon affected	Multiple examples are evenly distributed in a vegetated polygon, but none are large enough to pull out as 9300.
	NA	Development is not applicable when the MapUnit is 9210, 9220, 9801.

Anthropogenic Alteration: Level of impact on vegetation by anthropogenic clearing through tillage, scraping, grazing, etc. Fire effects are not considered in this category. This captures past disturbances in the landscape which are still visible through their impact on vegetation when that impact is not significant enough to be a "line-former." This attribute can also be used when small-scale effects are present that may cause a break in cover class, but this break affects an area less than the MMU rule for the vegetation type in question.

Code	Range	Example
	none visible	No "ghost" lines of tilling, differential effects of enclosure/exclosure fencing, effects of grazing/browsing, etc. are visible.
1	less than 33% of polygon is affected and/or impact is seen but does not affect vegetation density (as broken down here) or type	Less than 1/3 of a vegetation polygon has visible evidence of clearing, prior agricultural activity or other effects.
2	between 33%-66% of the polygon is affected	A vegetation polygon has >1/3 but <2/3 visible effects of clearing, prior agricultural or other effects.
3	>66% of polygon affected	A vegetation polygon has >2/3 visible effects of clearing, prior agricultural or other effects.
	NA	Anthropogenic alteration is not applicable when the MapUnit is 9801.

Hydrologic Modification (yes/no): Is the vegetation stand modified by a hydrologic impediment? This is used to identify stands of desert vegetation that have their extent directly impacted by restricted sheet flow or active channel flow crossing under a road, railroad, levee, etc. Examples include polygons where: 1) washes have expanded on the upslope side or contracted on the downslope side of the impediment (typically a berm or levee), or 2) railroad or highway berms have eliminated natural sheet flow downslope across alluvial fans and bajadas, or other slopes. The effect must create a line-forming break such as in vegetation type, shrub cover, tree cover, or herbaceous cover. The modifier is only attributed to the polygon down-slope of the impediment. Drainage ditches conveying flow off the side of a road (though often visible on imagery) are not considered unless they make a line-forming break in the vegetation.

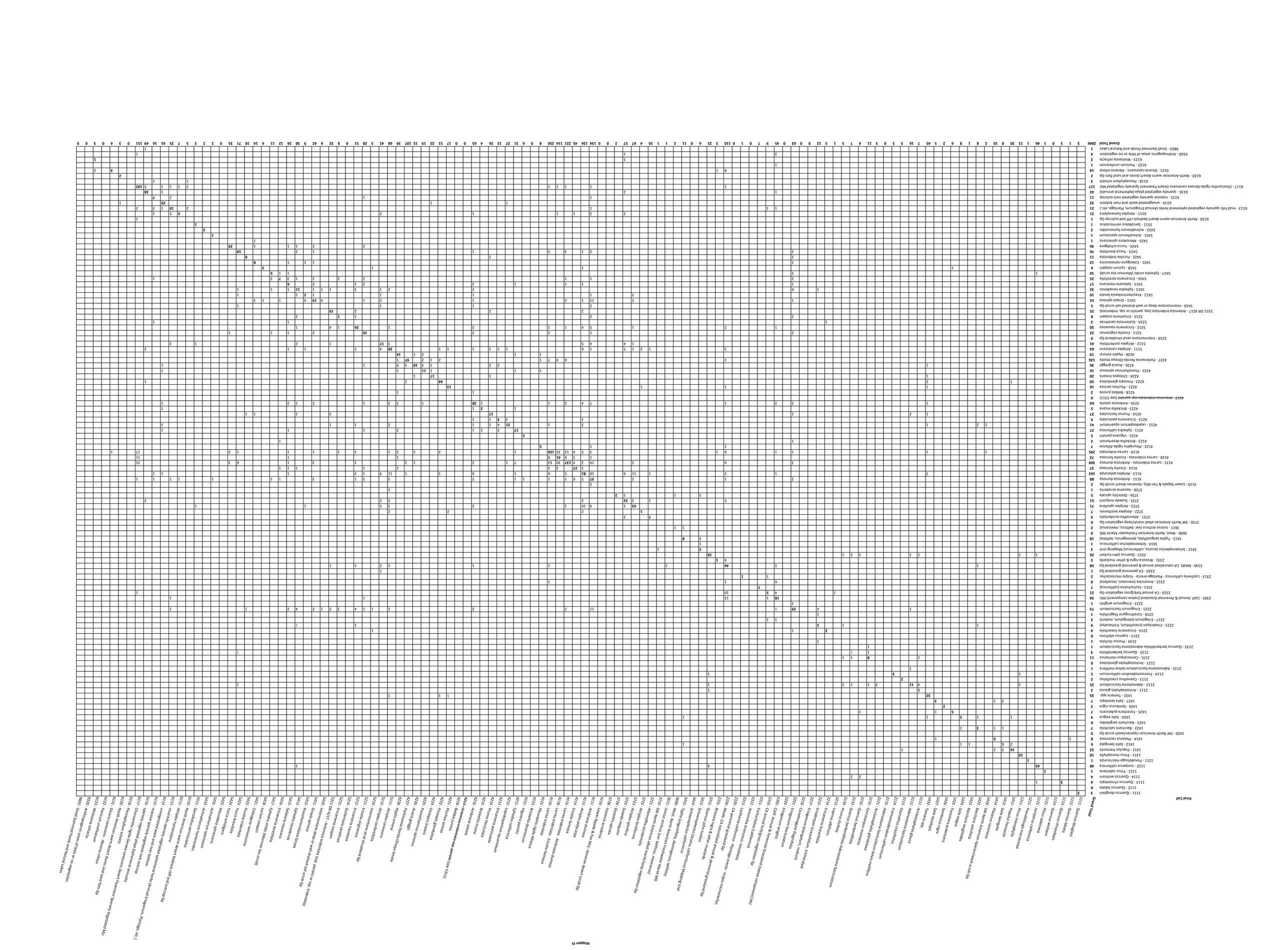
Estimated area of identifiable vegetation viewed: It is important to see as much of the sample polygon as possible. FVs in which less than 15% of the polygon has been sampled may be unusable.

Is this a "multiple" point assessment? Indicate if the FV is one of a number of points taken in the same mapped polygon. As discussed above, if the assessed polygon contains more than one vegetation type, an additional point *should* be taken in each additional stand that is > mmu within the mapped polygon. Multiple points *may* be taken in very large polygons even when the vegetation type is the same.

Please note: checking the box to the right of each category is an easy way to be certain the FV sample is complete.

Appendix G

Contingency Table


Mapper PI
Final Cull
Grand Total
2846
1111 - Quercus douglasii 3
1112 - Quercus lobata 0
1113 - Quercus chrysolepis 4
1114 - Quercus wislizeni 4
1121 - Pinus sabiniana 1
1122 - Juniperus californica 48
1211 - Pseudotsuga macrocarpa 1
1411 - Populus fremontii 22
1412 - Salix lasiolepis 6
1414 - Platanus racemosa 8
1420 - SW North American riparian/wash scrub 0
1422 - Salix exigua 9
1423 - Baccharis salicifolia 0
1425 - Forestiera pubescens 7
1426 - Sambucus nigra 2
1427 - Salix lasiolepis 7
1432 - Tamarix spp. 35
2111 - Arctostaphylos glauca 2
2112 - Adenostoma fasciculatum 25
2113 - Ceanothus crassifolius 2
2114 - Fremontodendron californicum 5
2115 - Adenostoma fasciculatum-Salvia mellifera 1
2121 - Arctostaphylos glandulosa 0
2132 - Quercus berberidifolia 3
2133 - Quercus berberidifolia-Adenostoma fasciculatum 1
2134 - Prunus ilicifolia 1
2213 - Lupinus albifrons 0
2214 - Eriogonum kennedyi 4
2215 - Fouquieria splendens 9
2217 - Eriogonum (elongatum, nudum) 2
2218 - Coreopsis lanceolata 1
2222 - Eriogonum wrightii 1
2310 - CA annual forb/grass vegetation 21
2320 - CA perennial grassland 1
2330 - Medit. CA naturalized annual & perennial grassland 58
2412 - Sclerocarya birrea & other nurseries 5
3111 - Artemisia tridentata 21
3112 - Eriodictyon trichocalyx 32
3113 - Adenostoma fasciculatum-Arctostaphylos spp. 42
3114 - Ceanothus megacarpus 12
3115 - Adenostoma fasciculatum-Ceanothus spp. 10
3116 - Quercus agrifolia-Heteromeles arbutifolia 3
3117 - Quercus agrifolia-Umbellularia californica 1
3118 - Quercus agrifolia-Platanus racemosa 1
3119 - Quercus agrifolia-Sambucus nigra 1
3120 - Quercus agrifolia-Toxicodendron diversilobum 1
3121 - Quercus agrifolia-Fraxinus dipetala 1
3122 - Quercus agrifolia-Fraxinus trifoliata 1
3123 - Quercus agrifolia-Fraxinus velutina 1
3124 - Quercus agrifolia-Prunus ilicifolia 1
3125 - Quercus agrifolia-Quercus berberidifolia 1
3126 - Quercus agrifolia-Quercus douglasii 1
3127 - Quercus agrifolia-Quercus lobata 1
3128 - Quercus agrifolia-Quercus wislizeni 1
3129 - Quercus agrifolia-Rhamnus crocea 1
3130 - Quercus agrifolia-Rhamnus ilicifolia 1
3131 - Quercus agrifolia-Salvia spp. 1
3132 - Quercus agrifolia-Sambucus nigra 1
3133 - Quercus agrifolia-Toxicodendron diversilobum 1
3134 - Quercus agrifolia-Umbellularia californica 1
3135 - Quercus agrifolia-Xylococcus bicolor 1
3136 - Quercus agrifolia-Yucca whipplei 1
3137 - Quercus berberidifolia-Adenostoma fasciculatum 1
3138 - Quercus berberidifolia-Arctostaphylos glandulosa 1
3139 - Quercus berberidifolia-Ceanothus megacarpus 1
3140 - Quercus berberidifolia-Ceanothus spinosus 1
3141 - Quercus berberidifolia-Cercocarpus montanus 1
3142 - Quercus berberidifolia-Fraxinus dipetala 1
3143 - Quercus berberidifolia-Fraxinus velutina 1
3144 - Quercus berberidifolia-Heteromeles arbutifolia 1
3145 - Quercus berberidifolia-Prunus ilicifolia 1
3146 - Quercus berberidifolia-Quercus agrifolia 1
3147 - Quercus berberidifolia-Quercus douglasii 1
3148 - Quercus berberidifolia-Quercus lobata 1
3149 - Quercus berberidifolia-Quercus wislizeni 1
3150 - Quercus berberidifolia-Rhamnus crocea 1
3151 - Quercus berberidifolia-Rhamnus ilicifolia 1
3152 - Quercus berberidifolia-Salvia spp. 1
3153 - Quercus berberidifolia-Sambucus nigra 1
3154 - Quercus berberidifolia-Toxicodendron diversilobum 1
3155 - Quercus berberidifolia-Umbellularia californica 1
3156 - Quercus berberidifolia-Xylococcus bicolor 1
3157 - Quercus berberidifolia-Yucca whipplei 1
3158 - Quercus douglasii-Arctostaphylos glandulosa 1
3159 - Quercus douglasii-Ceanothus megacarpus 1
3160 - Quercus douglasii-Ceanothus spinosus 1
3161 - Quercus douglasii-Cercocarpus montanus 1
3162 - Quercus douglasii-Fraxinus dipetala 1
3163 - Quercus douglasii-Fraxinus velutina 1
3164 - Quercus douglasii-Heteromeles arbutifolia 1
3165 - Quercus douglasii-Prunus ilicifolia 1
3166 - Quercus douglasii-Quercus agrifolia 1
3167 - Quercus douglasii-Quercus berberidifolia 1
3168 - Quercus douglasii-Quercus lobata 1
3169 - Quercus douglasii-Quercus wislizeni 1
3170 - Quercus douglasii-Rhamnus crocea 1
3171 - Quercus douglasii-Rhamnus ilicifolia 1
3172 - Quercus douglasii-Salvia spp. 1
3173 - Quercus douglasii-Sambucus nigra 1
3174 - Quercus douglasii-Toxicodendron diversilobum 1
3175 - Quercus douglasii-Umbellularia californica 1
3176 - Quercus douglasii-Xylococcus bicolor 1
3177 - Quercus douglasii-Yucca whipplei 1
3178 - Quercus lobata-Arctostaphylos glandulosa 1
3179 - Quercus lobata-Ceanothus megacarpus 1
3180 - Quercus lobata-Ceanothus spinosus 1
3181 - Quercus lobata-Cercocarpus montanus 1
3182 - Quercus lobata-Fraxinus dipetala 1
3183 - Quercus lobata-Fraxinus velutina 1
3184 - Quercus lobata-Heteromeles arbutifolia 1
3185 - Quercus lobata-Prunus ilicifolia 1
3186 - Quercus lobata-Quercus agrifolia 1
3187 - Quercus lobata-Quercus berberidifolia 1
3188 - Quercus lobata-Quercus douglasii 1
3189 - Quercus lobata-Quercus wislizeni 1
3190 - Quercus lobata-Rhamnus crocea 1
3191 - Quercus lobata-Rhamnus ilicifolia 1
3192 - Quercus lobata-Salvia spp. 1
3193 - Quercus lobata-Sambucus nigra 1
3194 - Quercus lobata-Toxicodendron diversilobum 1
3195 - Quercus lobata-Umbellularia californica 1
3196 - Quercus lobata-Xylococcus bicolor 1
3197 - Quercus lobata-Yucca whipplei 1
3198 - Quercus wislizeni-Arctostaphylos glandulosa 1
3199 - Quercus wislizeni-Ceanothus megacarpus 1
3200 - Quercus wislizeni-Ceanothus spinosus 1
3201 - Quercus wislizeni-Cercocarpus montanus 1
3202 - Quercus wislizeni-Fraxinus dipetala 1
3203 - Quercus wislizeni-Fraxinus velutina 1
3204 - Quercus wislizeni-Heteromeles arbutifolia 1
3205 - Quercus wislizeni-Prunus ilicifolia 1
3206 - Quercus wislizeni-Quercus agrifolia 1
3207 - Quercus wislizeni-Quercus berberidifolia 1
3208 - Quercus wislizeni-Quercus douglasii 1
3209 - Quercus wislizeni-Quercus lobata 1
3210 - Quercus wislizeni-Rhamnus crocea 1
3211 - Quercus wislizeni-Rhamnus ilicifolia 1
3212 - Quercus wislizeni-Salvia spp. 1
3213 - Quercus wislizeni-Sambucus nigra 1
3214 - Quercus wislizeni-Toxicodendron diversilobum 1
3215 - Quercus wislizeni-Umbellularia californica 1
3216 - Quercus wislizeni-Xylococcus bicolor 1
3217 - Quercus wislizeni-Yucca whipplei 1
3218 - Rhamnus crocea-Arctostaphylos glandulosa 1
3219 - Rhamnus crocea-Ceanothus megacarpus 1
3220 - Rhamnus crocea-Ceanothus spinosus 1
3221 - Rhamnus crocea-Cercocarpus montanus 1
3222 - Rhamnus crocea-Fraxinus dipetala 1
3223 - Rhamnus crocea-Fraxinus velutina 1
3224 - Rhamnus crocea-Heteromeles arbutifolia 1
3225 - Rhamnus crocea-Prunus ilicifolia 1
3226 - Rhamnus crocea-Quercus agrifolia 1
3227 - Rhamnus crocea-Quercus berberidifolia 1
3228 - Rhamnus crocea-Quercus douglasii 1
3229 - Rhamnus crocea-Quercus lobata 1
3230 - Rhamnus crocea-Quercus wislizeni 1
3231 - Rhamnus crocea-Rhamnus ilicifolia 1
3232 - Rhamnus crocea-Salvia spp. 1
3233 - Rhamnus crocea-Sambucus nigra 1
3234 - Rhamnus crocea-Toxicodendron diversilobum 1
3235 - Rhamnus crocea-Umbellularia californica 1
3236 - Rhamnus crocea-Xylococcus bicolor 1
3237 - Rhamnus crocea-Yucca whipplei 1
3238 - Rhamnus ilicifolia-Arctostaphylos glandulosa 1
3239 - Rhamnus ilicifolia-Ceanothus megacarpus 1
3240 - Rhamnus ilicifolia-Ceanothus spinosus 1
3241 - Rhamnus ilicifolia-Cercocarpus montanus 1
3242 - Rhamnus ilicifolia-Fraxinus dipetala 1
3243 - Rhamnus ilicifolia-Fraxinus velutina 1
3244 - Rhamnus ilicifolia-Heteromeles arbutifolia 1
3245 - Rhamnus ilicifolia-Prunus ilicifolia 1
3246 - Rhamnus ilicifolia-Quercus agrifolia 1
3247 - Rhamnus ilicifolia-Quercus berberidifolia 1
3248 - Rhamnus ilicifolia-Quercus douglasii 1
3249 - Rhamnus ilicifolia-Quercus lobata 1
3250 - Rhamnus ilicifolia-Quercus wislizeni 1
3251 - Rhamnus ilicifolia-Rhamnus crocea 1
3252 - Rhamnus ilicifolia-Salvia spp. 1
3253 - Rhamnus ilicifolia-Sambucus nigra 1
3254 - Rhamnus ilicifolia-Toxicodendron diversilobum 1
3255 - Rhamnus ilicifolia-Umbellularia californica 1
3256 - Rhamnus ilicifolia-Xylococcus bicolor 1
3257 - Rhamnus ilicifolia-Yucca whipplei 1
3258 - Salvia spp.-Arctostaphylos glandulosa 1
3259 - Salvia spp.-Ceanothus megacarpus 1
3260 - Salvia spp.-Ceanothus spinosus 1
3261 - Salvia spp.-Cercocarpus montanus 1
3262 - Salvia spp.-Fraxinus dipetala 1
3263 - Salvia spp.-Fraxinus velutina 1
3264 - Salvia spp.-Heteromeles arbutifolia 1
3265 - Salvia spp.-Prunus ilicifolia 1
3266 - Salvia spp.-Quercus agrifolia 1
3267 - Salvia spp.-Quercus berberidifolia 1
3268 - Salvia spp.-Quercus douglasii 1
3269 - Salvia spp.-Quercus lobata 1
3270 - Salvia spp.-Quercus wislizeni 1
3271 - Salvia spp.-Rhamnus crocea 1
3272 - Salvia spp.-Rhamnus ilicifolia 1
3273 - Salvia spp.-Sambucus nigra 1
3274 - Salvia spp.-Toxicodendron diversilobum 1
3275 - Salvia spp.-Umbellularia californica 1
3276 - Salvia spp.-Xylococcus bicolor 1
3277 - Salvia spp.-Yucca whipplei 1
3278 - Sambucus nigra-Arctostaphylos glandulosa 1
3279 - Sambucus nigra-Ceanothus megacarpus 1
3280 - Sambucus nigra-Ceanothus spinosus 1
3281 - Sambucus nigra-Cercocarpus montanus 1
3282 - Sambucus nigra-Fraxinus dipetala 1
3283 - Sambucus nigra-Fraxinus velutina 1
3284 - Sambucus nigra-Heteromeles arbutifolia 1
3285 - Sambucus nigra-Prunus ilicifolia 1
3286 - Sambucus nigra-Quercus agrifolia 1
3287 - Sambucus nigra-Quercus berberidifolia 1
3288 - Sambucus nigra-Quercus douglasii 1
3289 - Sambucus nigra-Quercus lobata 1
3290 - Sambucus nigra-Quercus wislizeni 1
3291 - Sambucus nigra-Rhamnus crocea 1
3292 - Sambucus nigra-Rhamnus ilicifolia 1
3293 - Sambucus nigra-Salvia spp. 1
3294 - Sambucus nigra-Toxicodendron diversilobum 1
3295 - Sambucus nigra-Umbellularia californica 1
3296 - Sambucus nigra-Xylococcus bicolor 1
3297 - Sambucus nigra-Yucca whipplei 1
3298 - Toxicodendron diversilobum-Arctostaphylos glandulosa 1
3299 - Toxicodendron diversilobum-Ceanothus megacarpus 1
3300 - Toxicodendron diversilobum-Ceanothus spinosus 1
3301 - Toxicodendron diversilobum-Cercocarpus montanus 1
3302 - Toxicodendron diversilobum-Fraxinus dipetala 1
3303 - Toxicodendron diversilobum-Fraxinus velutina 1
3304 - Toxicodendron diversilobum-Heteromeles arbutifolia 1
3305 - Toxicodendron diversilobum-Prunus ilicifolia 1
3306 - Toxicodendron diversilobum-Quercus agrifolia 1
3307 - Toxicodendron diversilobum-Quercus berberidifolia 1
3308 - Toxicodendron diversilobum-Quercus douglasii 1
3309 - Toxicodendron diversilobum-Quercus lobata 1
3310 - Toxicodendron diversilobum-Quercus wislizeni 1
3311 - Toxicodendron diversilobum-Rhamnus crocea 1
3312 - Toxicodendron diversilobum-Rhamnus ilicifolia 1
3313 - Toxicodendron diversilobum-Salvia spp. 1
3314 - Toxicodendron diversilobum-Sambucus nigra 1
3315 - Toxicodendron diversilobum-Umbellularia californica 1
3316 - Toxicodendron diversilobum-Xylococcus bicolor 1
3317 - Toxicodendron diversilobum-Yucca whipplei 1
3318 - Umbellularia californica-Arctostaphylos glandulosa 1
3319 - Umbellularia californica-Ceanothus megacarpus 1
3320 - Umbellularia californica-Ceanothus spinosus 1
3321 - Umbellularia californica-Cercocarpus montanus 1
3322 - Umbellularia californica-Fraxinus dipetala 1
3323 - Umbellularia californica-Fraxinus velutina 1
3324 - Umbellularia californica-Heteromeles arbutifolia 1
3325 - Umbellularia californica-Prunus ilicifolia 1
3326 - Umbellularia californica-Quercus agrifolia 1
3327 - Umbellularia californica-Quercus berberidifolia 1
3328 - Umbellularia californica-Quercus douglasii 1
3329 - Umbellularia californica-Quercus lobata 1
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3331 - Umbellularia californica-Rhamnus crocea 1
3332 - Umbellularia californica-Rhamnus ilicifolia 1
3333 - Umbellularia californica-Salvia spp. 1
3334 - Umbellularia californica-Sambucus nigra 1
3335 - Umbellularia californica-Toxicodendron diversilobum 1
3336 - Umbellularia californica-Xylococcus bicolor 1
3337 - Umbellularia californica-Yucca whipplei 1
3338 - Xylococcus bicolor-Arctostaphylos glandulosa 1
3339 - Xylococcus bicolor-Ceanothus megacarpus 1
3340 - Xylococcus bicolor-Ceanothus spinosus 1
3341 - Xylococcus bicolor-Cercocarpus montanus 1
3342 - Xylococcus bicolor-Fraxinus dipetala 1
3343 - Xylococcus bicolor-Fraxinus velutina 1
3344 - Xylococcus bicolor-Heteromeles arbutifolia 1
3345 - Xylococcus bicolor-Prunus ilicifolia 1
3346 - Xylococcus bicolor-Quercus agrifolia 1
3347 - Xylococcus bicolor-Quercus berberidifolia 1
3348 - Xylococcus bicolor-Quercus douglasii 1
3349 - Xylococcus bicolor-Quercus lobata 1
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3351 - Xylococcus bicolor-Rhamnus crocea 1
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3353 - Xylococcus bicolor-Salvia spp. 1
3354 - Xylococcus bicolor-Sambucus nigra 1
3355 - Xylococcus bicolor-Toxicodendron diversilobum 1
3356 - Xylococcus bicolor-Umbellularia californica 1
3357 - Xylococcus bicolor-Yucca whipplei 1
3358 - Yucca whipplei-Arctostaphylos glandulosa 1
3359 - Yucca whipplei-Ceanothus megacarpus 1
3360 - Yucca whipplei-Ceanothus spinosus 1
3361 - Yucca whipplei-Cercocarpus montanus 1
3362 - Yucca whipplei-Fraxinus dipetala 1
3363 - Yucca whipplei-Fraxinus velutina 1
3364 - Yucca whipplei-Heteromeles arbutifolia 1
3365 - Yucca whipplei-Prunus ilicifolia 1
3366 - Yucca whipplei-Quercus agrifolia 1
3367 - Yucca whipplei-Quercus berberidifolia 1
3368 - Yucca whipplei-Quercus douglasii 1
3369 - Yucca whipplei-Quercus lobata 1
3370 - Yucca whipplei-Quercus wislizeni 1
3371 - Yucca whipplei-Rhamnus crocea 1
3372 - Yucca whipplei-Rhamnus ilicifolia 1
3373 - Yucca whipplei-Salvia spp. 1
3374 - Yucca whipplei-Sambucus nigra 1
3375 - Yucca whipplei-Toxicodendron diversilobum 1
3376 - Yucca whipplei-Umbellularia californica 1
3377 - Yucca whipplei-Xylococcus bicolor 1
3378 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Ceanothus megacarpus 1
3379 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Ceanothus spinosus 1
3380 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Cercocarpus montanus 1
3381 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Fraxinus dipetala 1
3382 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Fraxinus velutina 1
3383 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Heteromeles arbutifolia 1
3384 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Prunus ilicifolia 1
3385 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Quercus agrifolia 1
3386 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Quercus berberidifolia 1
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3390 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Rhamnus crocea 1
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3392 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Salvia spp. 1
3393 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Sambucus nigra 1
3394 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Toxicodendron diversilobum 1
3395 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Umbellularia californica 1
3396 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Xylococcus bicolor 1
3397 - Adenostoma fasciculatum-Arctostaphylos glandulosa-Yucca whipplei 1
3398 - Adenostoma fasciculatum-Ceanothus megacarpus-Ceanothus spinosus 1
3399 - Adenostoma fasciculatum-Ceanothus megacarpus-Cercocarpus montanus 1
3400 - Adenostoma fasciculatum-Ceanothus megacarpus-Fraxinus dipetala 1
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3403 - Adenostoma fasciculatum-Ceanothus megacarpus-Prunus ilicifolia 1
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3405 - Adenostoma fasciculatum-Ceanothus megacarpus-Quercus berberidifolia 1
3406 - Adenostoma fasciculatum-Ceanothus megacarpus-Quercus douglasii 1
3407 - Adenostoma fasciculatum-Ceanothus megacarpus-Quercus lobata 1
3408 - Adenostoma fasciculatum-Ceanothus megacarpus-Quercus wislizeni 1
3409 - Adenostoma fasciculatum-Ceanothus megacarpus-Rhamnus crocea 1
3410 - Adenostoma fasciculatum-Ceanothus megacarpus-Rhamnus ilicifolia 1
3411 - Adenostoma fasciculatum-Ceanothus megacarpus-Salvia spp. 1
3412 - Adenostoma fasciculatum-Ceanothus megacarpus-Sambucus nigra 1
3413 - Adenostoma fasciculatum-Ceanothus megacarpus-Toxicodendron diversilobum 1
3414 - Adenostoma fasciculatum-Ceanothus megacarpus-Umbellularia californica 1
3415 - Adenostoma fasciculatum-Ceanothus megacarpus-Xylococcus bicolor 1
3416 - Adenostoma fasciculatum-Ceanothus megacarpus-Yucca whipplei 1
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3425 - Adenostoma fasciculatum-Ceanothus spinosus-Quercus lobata 1
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3429 - Adenostoma fasciculatum-Ceanothus spinosus-Salvia spp. 1
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