APPENDIX A

LIST OF IMPERIAL COUNTY RENEWABLE POWER AND RESOURCE PROJECTS

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Imperial County

Renewable Power and Resource Projects

Revised 10/08/14

Solar Energy

CUP	Project Name	Applicant	Assessors Parcel	Area-Location	Energy Source	Zoning	Project Acres	Mega-Watts	ENV	Status
10-0005	Chocolate Mountain	8minute Energy	003-110-014-000	Niland	Solar - PV	A2G	320.00	49.90	MND	**Approved Aug 2010**
10-0011	Imperial Solar South	C-Solar	052-190-022-000	Calexico (West of)	Solar - PV	A2/A3	946.60	200.00	EIR	**Approved June 2011**
10-0012	Imperial Solar West	C-Solar	034-360-076-000	Seeley (South of)	Solar - PV	A2/A3	1,130.00	250.00	EIR	**Approved June 2011**
10-0014	IV Solar Company	Sun Peak Solar	021-160-014-000	Niland	Solar - PV	A2U	123.00	23.00	MND	**Approved Oct 2011**
10-0017	Centinela Solar	Centinela Solar LLC	052-170-018-000	Calexico (West of)	Solar - PV	A2	2,067.00	275.00	EIR	**Approved Dec 2011**
10-0031	Mount Signal Solar	8 Minutenergy/ 82LV	052-210-013-000	Calexico (West of)	Solar - PV	A2R/A2	1,431.00	200.00	EIR	**Approved May 2012**
10-0032/33	Energy Source LLC	Energy Source	021-300-010-000 / 021-300-017-000	Niland	Solar - PV	A2/A3	486.00	80.00	MND	Pending Appeal
10-0034	Calipat Solar Farm I *	8 Minutenergy/ 70 SM	023-020-012-000	Calipatria	Solar - PV	A3	609.00	70.00	EIR	**Approved July 2012**
10-0036	Midway Solar Farm I	8 Minutenergy/ 83 WI	022-130-008-000	Calipatria	Solar - PV	A-2-RG	319.00	50.00	EIR	**Approved July 2012**
10-0037	Midway Solar Farm II	8 Minutenergy/ 97WI	022-130-005-001	Calipatria	Solar - PV	A-2-RG	803.00	155.00	EIR	**Approved July 2012**
11-0007	Campo Verde (USS MSS PERMITS LLC)	USS MSS Permits LLC	051-270-037-000	Calexico (West of)	Solar- PV	A2/ A3	1,443.00	140.00	EIR	**Approved Aug 2012**
11-0009	Calexico Solar Farm I-A	8 Minutenergy /88FT 8ME	052-210-001-000	Calexico (West of)	Solar - PV	A2/A3	720.00	100.00	EIR	**Approved April 2012**
11-0010	Calexico Solar Farm I-B	8 Minutenergy/ 88FT 8ME	052-190-011-000	Calexico (West of)	Solar - PV	A2/A3	610.00	100.00	EIR	**Approved April 2012**
11-0011	Calexico Solar Farm II-A	8 Minutenergy/ 89MA 8ME	059-110-003-000	Calexico (West of)	Solar - PV	A2	940.00	100.00	EIR	**Approved April 2012**
11-0012	Calexico Solar Farm II-B	8 Minutenergy/ 89MA 8ME	052-180-022-000	Calexico (West of)	Solar - PV	A2	530.00	100.00	EIR	**Approved April 2012**
11-0014	Heber Solar Energy Facility	ORMAT NEVADA	054-250-019-000	Heber	Solar - PV	A2G	80.00	14.00	MND	**Approved Oct 2011**
11-0018	Arkansas	Solar Gen 2 LLC / Arkansas	023-030-0210-000	Calipatria	Solar - PV	A2	481.00	50.00	EIR	**Approved May 2012**
11-0020	Alhambra	Solar Gen 2 LLC / Alhambra	024-350-004-000	Calipatria	Solar - PV	A3	482.00	50.00	EIR	**Approved May 2012**
11-0021	Sonora	Solar Gen 2 LLC / Sonora	025-280-017-000	Calipatria	Solar - PV	A2	488.00	50.00	EIR	**Approved May 2012**
12-0009	Imperial Valley Solar 2, LLC	IV Solar 2	003-240-009-000	Niland	Solar - PV	A3	158.65	20.00	EIR	**Approved July 2013**
12-0017	Wisteria Ranch Solar	Tenaska Solar	052-170-014-000	So of I-8/Westside Ma	Solar - PV	A-2/ A-3	2,660.00	250.00	EIR	EIR in process
13-0011 -	Seville Solar Farm	Imperial Solar Holdings LLC	018-010-025-000	Borrego Springs	Solar - PV	A2	1,238.00	135.00	EIR	**Appproved Oct 2014**
13-0054-57	Iris Cluster**	8 Minutenergy	059-050-001-000	Calexico (West of)	Solar - PV	A-2/	1,422.00	360.00	EIR	EIR in process
						Total	**19,487.25**	**2,821.90**		

** Calipat Solar Farm I: is in process to be split into three Projects CUP 13-0031/32/33 Wilkinson, Lindsey, Calipat*

*** Iris Cluster includes Ferrell Solar Farm, Iris Solar Farm, Lyons Solar Farm, and Rockwood Solar Farm*

Total Approved	**13,681.25**	**1,996.90**
Total in Process	**5,806.00**	**825.00**

Imperial County
Renewable Power and Resource Projects

Alternative Fuel

CUP	Project Name	Applicant	Assessors Parcel	Area-Location	Energy Source	Zoning	Project Acres	Mega-Watts	ENV	Status
12-0015	California Ethanol & Power	SKS Holding	040-240-007-000	Keystone	Ethanol	A-2	160.00	50.00	EIR	**Approved**
13-0030	Canergy	Canergy Rockwood LLC.	037-070-004-000	Brawley	Ethanol	M-2	80.00	**N/A**	EIR	**In Process**
12-0014	Oberon Fuels	Henrietta Farms	037-070-013-000	Brawley	DME	M-2	4.00	**N/A**	MND	**Approved**
						Subtotal 1	**244.00**	**50.00**		

Wind

CUP	Project Name	Applicant	Assessors Parcel	Area-Location	Energy Source	Zoning	Project Acres	Mega-Watts	ENV	Status
10-0007	Ocotillo Express	Pattern Energy	033-280-002-000	Ocotillo	Wind	BLM	12,436.00	265.00	EIR/EIS	**Approved**
						Subtotal 2	**12,516.00**	**265.00**		

Geothermal / Mineral

CUP	Project Name	Applicant	Assessors Parcel	Area-Location	Energy Source	Zoning	Project Acres	Mega-Watts	ENV	Status
Geothermal Power Plants										
G10-0002	Hudson Ranch II (Flash)	HR Power II	022-010-009-000	Calipatria	Geothermal	A2RG	245.00	49.90	EIR	**Approved**
G10-0004	Orni 21 Wister (Binary)	Ormat	003-200-020-000	Niland	Geothermal	A3G	40.00	30.00	EIR	**In Process**
G 08-0023	Orni 19 (Binary)	Ormat	Various	Brawley	Geothermal	A2G	34.00	49.90	EIR	**Approved**
Geothermal Well Fields										
G13-0001	Imperial Wells Power (Explorati	Imperial Wells	020-050-078-000	Niland	Geothermal	S1-G/A2-G	26.00	**N/A**	ND	**Approved**
G13-0002	Exploratory well	State Land Hudson Ranch	020-010-030-000	Niland	Geothermal	S1-G	40.00	**N/A**	ND	**Approved**
Mineral Recover projects										
CUP 12-0004	Simbol I	Simbol Materials	020-100-044-000	Calipatria	Geothermal/ Minera	M2G-PE	65.00	**N/A**	EIR	**Approved**
CUP 12-0004	Simbol II	Simbol Minerals	022-010-009-000	Calipatria	Geothermal/Minerals	A2 RG	48.00	**N/A**	EIR	**Approved**
						Subtotal 3	**498.00**	**129.80**		

Renewable Energy and Resource Total	**13,258.00**	**444.80**
Solar Energy Project Total	**19,487.25**	**2,821.90**
Approximate Grand Total	**32,745.25**	**3,266.70**

APPENDIX B

LIST OF RENEWABLE ENERGY PROJECTS EAs, EIRs, AND EISs

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APPENDIX B: LIST OF RENEWABLE ENERGY PROJECTS EAs, EIRs, and EISs INCORPORATED BY REFERENCE

Project	Author	Doc Name	Date	Links	Other Information
Ocotillo Wind Energy Facility	United States Department of the Interior Bureau of Land Management	Proposed Plan Amendment & Final Environmental Impact Statement/ Final Environmental Impact Report for the Ocotillo Wind Energy Facility	Februar y 2012	http://www.icp ds.com/?pid=28 43	DOI Control #: DES 11-20 SCH No. 2010121055 Publication Index #: BLM/CA/ES-2011-15+1793
Imperial Solar Energy West	BRG Consulting, Inc.	Final Environmental Impact Report/Environmental Assessment for the Imperial Solar Energy Center West	July 2011	http://www.icp ds.com/?pid=39 82	SCH #2010061037 Conditional Use Permit (CUP) #10-0012 Variance: #V10-0007 BLM Right-of-Way: CACA-51644 EA Number: 2010-64
East Brawley Geothermal (Orni 19 Project)	PMC	County of Imperial East Brawley Geothermal Final Environmental Impact Report	May 2012	http://www.icp ds.com/?pid=26 66	SCH: 2010061054
Campo Verde Solar	egi, ericsson-grant inc.	Final Environmental Impact Report for the Campo Verde Solar Project	July 24, 2012	http://www.icp ds.com/?pid=31 38	SCH. No. 2011111049 CUP #11-0007 Variance #V12-0008
Imperial Valley Solar Company 2	Chambers Group Inc.	Final Environmental Impact Report, Imperial Valley, Solar Company 2 Project	May 2013	http://www.icp ds.com/?pid=33 06	CUP # 12-009
Centinela Solar	egi, ericsson-grant inc.	Final Environmental Impact Report for the Centinela Solar Energy Project	Decemb er 2011	http://www.icp ds.com/?pid=35 90	SCH. No. 2010111056 Conditional Use Permit: CUP #10-0017 Variance: #11-0003
CE&P Imperial Valley 1 Sugarcane & Sweet Sorghum-to-ethanol Electricity & Bio-methane facility	egi, ericsson-grant inc.	Final Environmental Impact Report for California Ethanol & Power Imperial Valley 1	August 2013	http://www.icp ds.com/?pid=34 27	SCH. NO. 2012101036 Specific Plan Amendment (SP 12-0002) Conditional Use Permit (CUP 12-0015) Zone Change (ZC 12-0003) Variance (V 12-0011)
Mount Signal Solar Farm	HDR Engineering, Inc.	Final Environmental Impact Report Mount Signal and Calexico Solar Farm Projects Imperial County, California	March 2012	http://www.icp ds.com/?pid=29 28	

APPENDIX B: LIST OF RENEWABLE ENERGY PROJECTS EAs, EIRs, and EISs INCORPORATED BY REFERENCE

Project	Author	Doc Name	Date	Links	Other Information
Cluster I Solar Power Project (Includes Calipat Solar Farm I, Midway Solar Farm I, and Midway Solar Farm II)	Environmental Science Associates	Cluster I Solar Power Project Final Environmental Impact Report	June 2012	http://www.icpds.com/?pid=2949	SCH No. 2011071083
Solar Gen 2 Solar Array Project (includes Arkansas, Alhambra, Mayflower, and Sonora Solar Projects)	Environmental Science Associates	Final Environmental Impact Report Solar Gen 2 Solar Array Arkansas Solar Mayflower Solar Alhambra Solar Sonora Solar	April 2012	http://www.icpds.com/?pid=3064	SCH# 2011121011
Orni 21, LLC Geothermal	Ecology and Environment, inc.	Draft Environmental Impact Report for ORNI 21, LLC Geothermal Project	September 2013	http://www.icpds.com/?pid=3809	Geothermal Permit #G10-0004 State Clearinghouse #2011061029
Imperial Solar South	BRG Consulting, Inc.	Final EIR/EA for the Imperial Solar Energy Center South	April 2011	http://www.blm.gov/ca/st/en/fo/elcentro/nepa/isec_south.html	SCH #2010061038 Conditional Use Permit: CUP #10-0011 Variance: #V10-0006 BLM Right-of-Way: CACA-51645/CACA-52359 EA Number: 2010-64/2011-0007
Hudson Ranch II Geothermal Plant and the Simbol Calipatria Plant II Project	Ecology and Environment, inc.	Final Environmental Impact Report for the Proposed Hudson Ranch Power II Geothermal Project, Hudson Ranch Power II, LLC and Simbol Calipatria Plant II, Simbol, Inc. (SCH No. 2010101065)	August 2012	http://imperial.granicus.com/MetaViewer.php?view_id=2&clip_id=375&meta_id=47327	SCH No. 2010101065
Desert Renewable Energy Conservation Plan		Various documents		http://www.drecp.org/documents/	
Simbol Calipatria Plant I (SmCP-1) Project		Draft Environmental Impact Report for the Simbol Calipatria Plant I Project (SCH #2012041067			

APPENDIX B: LIST OF RENEWABLE ENERGY PROJECTS EAs, EIRs, and EISs INCORPORATED BY REFERENCE

Project	Author	Doc Name	Date	Links	Other Information
Truckhaven Geothermal Leasing Area	Ecology and Environment, inc.	Final Environmental Impact Statement for the Truckhaven Geothermal Leasing Area	October 2007	http://www.blm.gov/ca/st/en/fo/elcentro/nepa/truckhaven.html	Publication Index #: BLM/CA/ES-2008-004+3200
the West Chocolate Mountains Renewable Energy Evaluation Area	Ecology and Environment, inc.	Final Environmental Impact Statement and Proposed California Desert Conservation Area Plan Amendment for the West Chocolate Mountains Renewable Energy Evaluation Area	November 2012	http://www.blm.gov/ca/st/en/fo/elcentro/nepa/wcm.html	Publication Index #: BLM/CA/ES-2013-001+1793
North Salton Sea: Geothermal	Department of the Interior Bureau of Land Management	North Salton Sea: Geothermal – Final Environmental Assessment Record	May 1979		

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APPENDIX C

DRECP LAND COVERS

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2012 Vegetation Map in Support of the Desert Renewable Energy Conservation Plan

Interim Report (1.1)

By
Vegetation Classification and Mapping Program
California Department of Fish and Game
in collaboration with
Aerial Information Systems, Inc.

For the
Desert Renewable Energy Conservation Planning Program and
California Energy Commission

June 2012

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- Biodiversity Data Branch: Kristi Lazar
- Habitat Conservation Planning Branch: Junko Hoshi

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California Department of Parks and Recreation: Carrie Bemis

California Energy Commission: Scott Flint, Misa Milliron, Paul Richens, Kristi Chew

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Mojave Desert Manager's Group: Fon Duke

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National Park Service: Tasha LaDoux

Saint Mary's College: Phil Leitner

Tejon Ranch Conservancy: Mike White

US Bureau of Land Management, Barstow Field Office: Anthony Chavez
- Ridgecrest Field Office: Marty Dickes, Glenn Harris, Hector Villalobos, Matt Duarte (SCA Conservation Corps);
- California State Office: Christina Lund

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- Fort Irwin National Training Center: Liana Aker, Clarence Everly, Dave Housman, Mark Hessing, George Peck
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We apologize to anyone we may have left off of this list.

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Abstract

The California Department of Fish and Game (CDFG) Vegetation Classification and Mapping Program (VegCAMP) and contractor Aerial Information Systems (AIS) created a fine-scale vegetation map of a portion of the western Mojave Desert in California. The mapped area is bounded to the west and south by USDA Ecoregional Subsection 322Ag of the Mojave Desert (Miles and Goudey 1997). To the east, the portion mapped by AIS (approx. 4,202,000 acres) is bounded by the borders of a vegetation map produced in 2004 for the Mojave Desert Ecosystem Program (MDEP). VegCAMP mapped a portion of the area mapped previously for the MDEP (approx. 776,000 acres) using the finer-scale rules and classification that AIS used for the larger portion (see Figure 1). The boundary of VegCAMP's study area was chosen to eliminate an arbitrary hole in AIS's work area based on the MDEP boundary around Ord Mountain, absorb an additional core area for the Mojave Ground Squirrel, include more critical habitat area for the Desert Tortoise, and ensure access to 1-ft. ancillary imagery via ImageConnect©.

The vegetation classification follows Federal Geographic Data Committee (FGDC) and National Vegetation Classification Standards (NVCS). The classification is based on previous survey and classification work including the classification done for MDEP. An additional 98 Rapid Assessment vegetation field surveys were collected in 2011, and some additional mapping classes are based on those unclassified surveys. These classes are considered provisional until better understood (for example, the Ericameria cooperi provisional alliance). See Appendix A for the field form and protocol for the Rapid Assessment surveys.

The map was produced using heads up digitizing on a base of true-color and color infrared 2010 1-meter National Agricultural Imagery Program (NAIP) imagery. Supplemental imagery included Bing mapping services and true-color 1-foot aerial imagery available through GlobeXplorer ImageConnect©. The minimum mapping unit (MMU) is 10 acres; exceptions are made for wetlands and certain wash types (which were mapped to a 1 acre MMU) and areas characterized as human land use polygons (which were mapped to a 2.5 acre MMU).

This report and accompanying data are to be released at the end of June 2012. After this time, a review of AIS polygons and fieldwork will be performed to analyze the percentage of mapped polygons that have had some sort of field assessment related to this project. Additionally, some of the polygons that were mapped to higher levels in the NVCS hierarchy will be re-assessed and assigned to a lower level.

Purpose

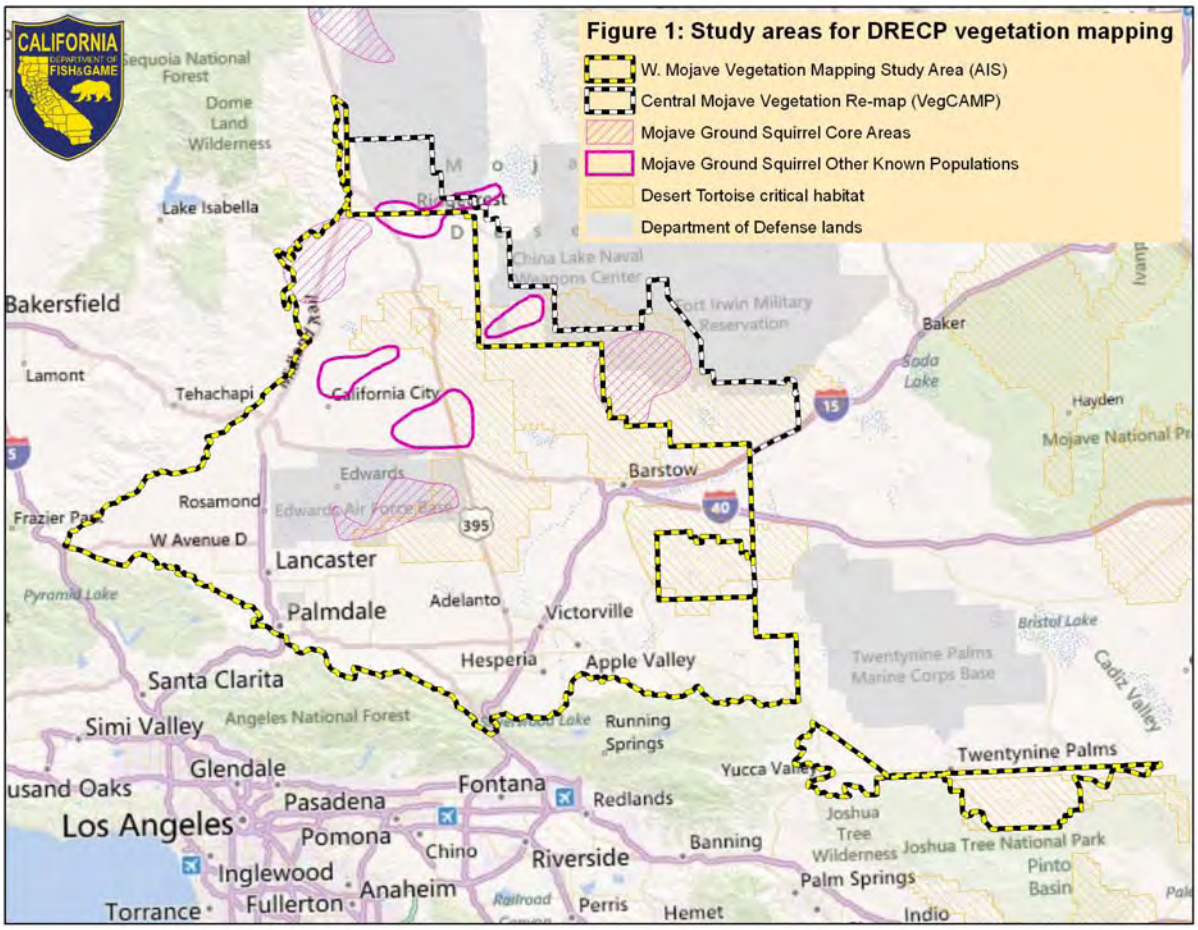
The purpose of the vegetation map is to assist with the Desert Renewable Energy Conservation Plan (DRECP). This map will provide planners with detailed information to help identify high quality habitat and rare communities. Although the primary purpose of the map is to document vegetation communities, it also provides 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 species covered in the DRECP, including the Mojave Ground Squirrel and Desert Tortoise. Please read the attribute descriptions for caveats.

Supplemental Information

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 (1998), the Mojave Desert Ecosystem Program's Vegetation Database (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). These were compiled and placed within the NVCS hierarchy as it stood in March of 2011. Please see Appendices B and C for the classification and key, respectively.

Figure 1: Study area boundaries



Delineation Rules
Lines are drawn both to distinguish between types (MapUnits) and to indicate vegetation cover breaks within a type. The following minimum mapping units are observed while making these delineations: 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.

An additional guideline establishes the approximate minimum width of a polygon: washes and riparian stands must be 90 ft. wide and upland vegetation must be 330 ft. wide. The appropriate MMUs must still be observed. This guideline isn't meant to exclude polygons where a small section falls below the minimum width, as long as the greater portion of the polygon meets the stated criteria.

Land use, including towns, mining, agriculture, and individual settlements, was handled using a special set of rules. These were designed to separate larger urban tracts as a whole, and to maintain the ability to have a vegetation type on a lightly used or re-vegetating area. See Appendix D for Land use rules.

Reconnaissance
Between February 2011 and October 2011, AIS staff and CDFG staff each conducted eight field trips throughout the mapping area with 1-2 crews per trip to perform reconnaissance of vegetation types. This reconnaissance allowed better matching of signatures seen on the imagery with the vegetation. Todd Keeler-Wolf of CDFG often accompanied AIS on their trips. 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 photo-interpreter 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. Excluding some duplicate observations, approximately 4600 reconnaissance observations were made. See Appendix E for a copy of the form used by CDFG staff during reconnaissance surveys.

Accuracy Assessment
From October 2011 through June 2012, 2387 accuracy assessments (AAs) were made throughout the mapping area. Assessments were done by navigating to polygons allocated from a module of completed vegetation polygons. 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. The assessments were stand-based, that is, both the type and the extent of the polygons were evaluated where possible. Additionally, all of the cover values and all disturbance attributes except roadedness were assessed, where possible. When a polygon could be divided due to the presence of multiple types, an assessment was done for each type. As with reconnaissance, some of the stands were assessed from a distance using a compass, laser rangefinder, binoculars, 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 a copy of the form used in accuracy assessments.

In the office, data from the field AA forms were entered into an Access database and the vegetation type recorded by the photo-interpreter was scored using the field surveys and accompanying ground photos. Cover and disturbance attributes were not scored, but were provided as feedback to the photo-interpreters.

Each assessment could receive a maximum of 5 points, with points given depending on how closely the photo-interpreter (PI) matched the type reported from the AA. Below is a table showing how these points were assigned**.**

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 AA 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 Macro Group 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 significant change in 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 AA field crew.	no score
L	Survey removed because field/PI data is 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 where the AA call was the same at multiple points).	no score

The map received an overall score of 82.6%. The table below summarizes the average score per type sampled. A contingency table for the area will be available in the final version of this report.

Vegetation Type	Average Score	# of Samples
Acacia greggii	4.0	24
Achnatherum hymenoides	5.0	2
Achnatherum speciosum	5.0	1
Adenostoma fasciculatum	4.1	25
Adenostoma fasciculatum-Salvia mellifera	4.0	1
Allenrolfea occidentalis	5.0	5
Ambrosia dumosa	3.8	67
Ambrosia salsola	3.3	54
Amsinckia (menziesii, tessellata)	4.9	7
Anthropogenic areas of little or no vegetation	2.8	5
Arctostaphylos glauca	4.0	2
Artemisia tridentata (including A. tridentata spp. parishii)	4.3	25
Atriplex canescens	4.0	43
Atriplex confertifolia	3.7	41
Atriplex hymenelytra	3.5	22

Vegetation Type	Average Score	# of Samples
Atriplex lentiformis	1.7	3
Atriplex polycarpa	3.9	145
Atriplex spinifera	4.0	71
Baccharis salicifolia	4.1	7
Brassica nigra & other mustards	5.0	2
Brickellia desertorum	4.0	2
Brickellia incana	4.2	5
Bromus rubens - Schismus (arabicus, barbatus)	4.9	11
CA annual forb/grass vegetation Gp	4.3	21
CA perennial grassland Gp	1.0	1
Calif. Annual & Perennial Grassland (native component) MU	4.7	27
Calif. Annual & Perennial Grassland MG	3.6	7
Ceanothus crassifolius	5.0	2
Cercocarpus montanus	4.6	11
Chilopsis linearis	4.8	19
Coleogyne ramosissima	4.1	22
Corethrogyne filaginifolia	4.0	1
Desert Pavement Mapping Unit	4.5	27
Distichlis spicata	3.6	5
Encelia farinosa	4.3	19
Encelia virginensis	3.6	24
Ephedra californica	4.3	23
Ephedra nevadensis	3.7	35
Ephedra viridis	3.6	15
Ericameria cooperi	2.9	8
Ericameria linearifolia	4.0	4
Ericameria nauseosa	3.6	51
Ericameria paniculata	4.1	9
Ericameria teretifolia	3.6	25
Eriodictyon (crassifolium, trichocalyx)	3.9	9
Eriogonum (elongatum, nudum)	5.0	2
Eriogonum fasciculatum	3.7	73
Eriogonum wrightii	4.0	1
Eschscholzia (californica)	5.0	7
Forestiera pubescens	4.4	7
Fremontodendron californicum	3.4	5
Geraea canescens-Chorizanthe rigida MU	5.0	2
Grayia spinosa	3.6	60
Gutierrezia sarothrae	3.3	3
Hyptis emoryi	4.3	3
Intermontane deep or well-drained soil scrub Gp	3.2	5
Isocoma acradenia	3.0	1
Juncus arcticus (var. balticus, mexicanus)	3.0	2
Juniperus californica	4.8	48
Krascheninnikovia lanata	3.3	10
Larrea tridentata	4.3	141
Larrea tridentata - Ambrosia dumosa	4.2	172
Larrea tridentata - Encelia farinosa	4.4	12

Vegetation Type	Average Score	# of Samples
Lasthenia californica - Plantago erecta - Vulpia microstachys	5.0	2
Lepidospartum squamatum	4.0	42
Lycium cooperi	3.5	6
massive sparsely vegetated rock outcrop	4.2	13
Medit. CA naturalized annual & perennial grassland Gp	4.3	42
Menodora spinescens	4.0	1
mud hills sparsely vegetated ephemeral herbs (Annual Eriogonum, Plantago, etc.)	4.3	18
North American warm desert dunes and sand flats Gp	5.0	2
Panicum urvilleanum	2.0	1
Peucephyllum schottii	4.0	1
Pinus monophylla	5.0	10
Pinus sabiniana	5.0	1
Platanus racemosa	4.5	8
Pleuraphis rigida Alliance	4.8	5
Populus fremontii	4.5	22
Prosopis glandulosa	4.9	15
Prosopis pubescens	0.0	1
Prunus fasciculata	4.0	27
Prunus ilicifolia	4.0	1
Pseudotsuga macrocarpa	5.0	1
Psorothamnus spinosus	4.8	11
Purshia tridentata	4.5	11
Quercus berberidifolia	4.0	3
Quercus berberidifolia-Adenostoma fasciculatum	4.0	1
Quercus chrysolepis	4.5	4
Quercus douglasii	5.0	3
Quercus john-tuckeri	4.5	26
Quercus wislizeni	3.5	4
Salazaria mexicana	3.6	16
Salix exigua	3.9	9
Salix laevigata	3.8	6
Salix lasiolepis	4.0	7
Sambucus nigra	5.0	2
Sarcobatus vermiculatus	5.0	1
Schoenoplectus spp. Mapping Unit	4.3	3
Senna armata (not currently defined)	4.0	2
sparsely vegetated playa (ephemeral annuals)	4.8	36
Suaeda moquinii	4.2	36
Tamarix spp.	5.0	18
Typha (angustifolia, domingensis, latifolia)	5.0	8
unvegetated wash and river bottom	5.0	28
Viguiera parishii	5.0	5
Yucca brevifolia	4.7	76
Yucca schidigera	4.3	48

Portion of Map Visited
The final report will include an evaluation of the percent of mapped polygons that had some type of field assessment (rapid assessment, reconnaissance observation, accuracy assessment).

Map Attributes

NVCSName/NVCSLevel: The standardized name/level of the vegetation description used in the National Vegetation Classification System (see http://biology.usgs.gov/npsveg/nvcs.html). Since the NVCS does not have categories for human land use or otherwise unvegetated land, those descriptions were drawn from the California Wildlife Habitat Relationship.

MapUnit: The code for a vegetation alliance or group or an unvegetated type like playa; or a code for a land use for polygons that are not natural vegetation (please see the classification list and key).

Conifer Cover (ConCov): Percent bird's-eye cover of conifers within a vegetation stand, broken into the classes in the table below. "Bird's-eye" total cover is what can be seen on an air photo, i.e., it does not include the cover of understory layers obscured by overstory layers.

Code	Range	Example
0	none	There are no conifers in this stand.
1	>0-1%	*Juniperus californica, Pinus monophylla, P. sabiniana* are widely scattered as emergents. Note: if *J. californica* is present with >1% *Yucca brevifolia*, this is a *Y. brevifolia* alliance.
2	>1-5%	Conifers are sparse and unevenly scattered to dispersed and evenly distributed. If no other tree species have greater cover and the type is 1000 = TEMPERATE FOREST SUBCLASS, then the conifer is usually not an indicator species (the nominal type). The exception is *Juniperus californica* over scrub or herb understory. For example, *Pinus sabiniana* at 2% with *Quercus douglasii* at 11% would be a *Quercus douglasii* type, but *J. californica* at 5% over shrubs at 14% would be a *J. californica* type.
3	>5-15%	This is a common cover class for *Juniperus californica* in the western Mojave Desert, and an occasional cover class for *Pinus monophylla* or *Pseudotsuga macrocarpa* in and near the Transverse Ranges.
4	>15-25%	This is an occasional cover class for *Juniperus californica*, *Pinus monophylla*, and *Pseudotsuga macrocarpa.*
5	>25-50%	This class is unusual, except perhaps in the most shaded/mesic setting of lower canyons in the Transverse Range.
6	>50-75%	This cover class is unlikely in the mapping area.
7	>75-100%	This cover class is highly unlikely in the mapping area.
9	NA	Conifer cover is not applicable when the MapUnit is 9210, 9220, 9300, 9310, 9800, 9801, 9803, 9804, 9805.

Hardwood Cover (HdwdCov): Percent bird's-eye cover of hardwoods within a vegetation stand, broken into the following classes:

Code	Range	Example
0	none	This class is typical for most desert upland away from the Transverse or Tehachapi ranges.
1	>0-1%	The stand may include isolated *Platanus racemosa, Populus fremontii*, *Salix gooddingii*, or *Salix laevigata* in riparian scrub.
2	>1-5%	A low cover of evenly distributed riparian trees is indicated. If *Populus fremontii*, *Platanus racemosa*, *Salix gooddingii* or other tree willows are evenly distributed over marginally higher cover of riparian shrubs, the stand may be labeled as the appropriate tree alliance type.

Code	Range	Example
3	>5-15%	This class is typical of open *Quercus douglasii* or *Quercus lobata* stands in the Transverse or Tehachapi ranges, or of riparian woodlands with *Populus fremontii*, *Salix gooddingii*, etc.
4	>15-25%	This class would be an uncommonly high density of upland oak types or riparian woodlands.
5	>25-50%	This class would be an unusually high cover of upland oak, or riparian woodlands dominated by hardwoods.
6	>50-75%	This would indicate a quite uncommon, locally dense riparian stand of trees.
7	>75-100%	Cover this high is not expected in the study area
9	NA	Hardwood cover is not applicable when the MapUnit is 9210, 9220, 9300, 9310, 9800, 9801, 9803, 9804, 9805.

Joshua tree cover (YUBRcover): Percent bird's-eye cover of Yucca brevifolia within a vegetation stand, broken into the following classes:

Code	Range	Example
0	none	There are no visible *Yucca brevifolia* in the stand, although widely scattered juveniles <3m tall may be included.
1	present, but <1% and unevenly distributed	This is common in desert shrublands of *Larrea tridentata-Ambrosia dumosa, Atriplex polycarpa, Atriplex canescens, Coleogyne ramosissima,* etc. Yucca brevifolia tree signature may be visible, but individuals are not evenly distributed and are widely dispersed.
2	present, between 1 and 5% and evenly distributed	This class commonly denotes an open, tree-size *Yucca brevifolia* woodland, usually evenly distributed with higher shrub cover.
3	> 5%, generally dense clonal stands or occasionally in dense woodlands of spreading tree morphs (rare)	This density is usually only found at higher or wetter sites within the study area; it can occasionally involve non-clonal stands at highest density, as near the southwest side of Ft Irwin.
9	NA	Joshua tree cover is not applicable when MapUnit is 9210, 9220, 9300, 9310, 9800, 9801, 9803, 9804, 9805.

Total Tree Cover (TreeCov): Percent bird's-eye cover of trees (including Joshua Trees) within a vegetation stand, broken into the following classes:

Code	Range	Example
0	none	Most desert shrubland lacking emergent *Yucca brevifolia* falls into this class.
1	>0-1%	*Larrea tridentata-Ambrosia dumosa, Atriplex polycarpa, Atriplex spinifera, Coleogyne ramosissima*, etc. with isolated emergent tree-size *Juniperus californica, Pinus monophylla, Yucca brevifolia* are examples of this class, as well as wetlands with isolated tree *Salix* or *Populus.*
2	>1-5%	Most *Yucca brevifolia* or open *Juniperus californica* woodlands over a well-developed shrub cover are included. Desert washes with scattered *Chilopsis linearis, Psorothamnus spinosus* are other examples.
3	>5-15%	The highest density *Yucca brevifolia* (usually the short clonal type in west Mojave), well developed *Juniperus californica* woodland, and open *Quercus lobata, Q. douglasii* woodland in the Transverse and Tehachapi ranges fall in this class.
4	>15-25%	*Quercus lobata, Q. douglasii*, *Q. chrysolepis* woodlands in concavities in the Transverse and Tehachapi ranges are examples.

Code	Range	Example
5	>25-50%	This may be high-cover *Pseudotsuga macrocarpa* (with *Quercus chrysolepis*) stands in concavities in the Transverse Range on the edge of the ecoregion, or locally dense stands of *Populus fremontii* or other riparian trees.
6	>50-75%	This class is unlikely in the study area.
7	>75-100%	This class is highly unlikely in study area
9	NA	Tree cover is not applicable when the MapUnit is 9210, 9220, 9300, 9310, 9800, 9801, 9803, 9804, 9805

Shrub Cover (ShrubCov): Percent bird's eye cover of shrubs within a vegetation stand, broken into the following classes:

Code	Range	Example
0	none	There is no perennial shrub signature, ie: extensive cliffs and outcrops, extensive dunes or sand sheets, current agriculture, urban areas, etc.
1	>0-1%	These types are not defined by shrubs; they do not have an even distribution of shrubs (wetland or upland herbaceous vegetation).
2	>1-5%	Shrubs are widely distributed on harsh substrates, e.g., *Larrea tridentata-Ambrosia dumosa* or *Encelia farinosa* on steep rocky slopes, or old inactive alluvial surfaces.
3	>5-15%	Modal *Larrea tridentata-Ambrosia dumosa, Atriplex* spp. upland vegetation, active vegetated washes (e.g., *Ephedra californica*, *Ericameria paniculata, Ambrosia salsola*) fall in this range.
4	>15-25%	High cover *Larrea tridentata-Ambrosia dumosa* (as in west Mojave near Inyokern with high density *Ambrosia dumosa*), well developed *Coleogyne ramosissima* on moderate rocky slopes, well defined *Atriplex polycarpa* in washes and swales in the western portion of the study area are examples.
5	>25-50%	High cover chaparral of *Quercus john-tuckeri, Adenostoma fasciculatum, Eriogonum fasciculatum, Arctostaphylos glauca, Fremontodendron californicum*, and other chaparral or coastal sage scrub types may be found in the foothills of the Transverse, Tehachapi or Sierra Nevada ranges. Small stands of *Salix* or *Prosopis* associated with springs, stable reservoirs or other water bodies are in this range. This cover class is rare in the study area.
6	>50-75%	This is extremely rare in the mapping area.
7	>75-100%	Incidental, no stands in this range are known.
9	NA	Shrub cover is not applicable when the MapUnit is 9210, 9220, 9300, 9310, 9800, 9801, 9803, 9804, 9805.

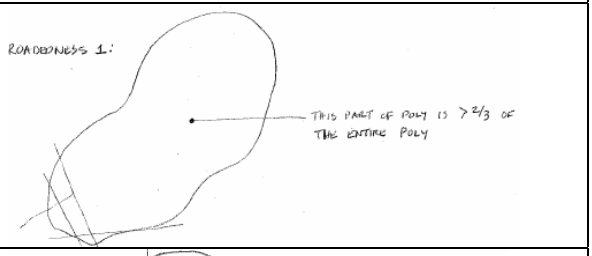
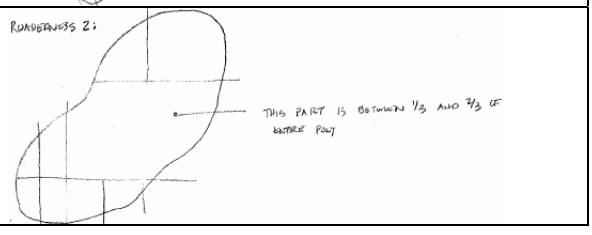
Herbaceous Cover (HerbCov): Percent bird's-eye cover of herbaceous plants within a vegetation stand, broken into the following classes:

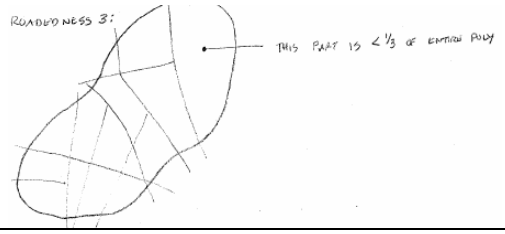
Code	Range	Example
1	0-2%	Steep slopes with low shrub cover (shrub cover class 2) and no herbaceous signature, ancient non-active alluvial fans.
2	>2-15%	Most standard *Larrea tridentata-Ambrosia dumosa* stands, wash stands of *Ambrosia salsola*, *Ephedra californica, Chilopsis linearis* without any surface moisture are expected to have herb covers in this class.
3	>15-40%	Most wetland woody and herbaceous polygons, and degraded *Larrea tridentata* or *Larrea tridentata-Ambrosia dumosa* have visible and evenly dispersed largely non-native herb cover.
4	>40%	Herb cover in this range is only found in dense wetlands, ie: local stands of *Typha, Juncus, Schoenoplectus*, etc.
9	NA	Herb cover is not applicable when the MapUnit is 9210, 9220, 9300, 9310, 9800, 9801, 9803, 9804, 9805.

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

Code	Range	Example
0	no evidence of exotics visible	This is expected on coarse rocky slopes, with no tawny or reddish *Schismus* or *Bromus rubens* signature, desert pavement, very steep bouldery slopes, etc.
1	patches of exotics visible, but cover not significant (relative cover to total <33%)	General *Larrea tridentata-Ambrosia dumosa* without high roadedness or degraded understory usually fall in this class. S*chismus* or *Bromus* may be visible in relatively small discrete patches (<½ of the substrate signature), but will not present an extensive signature.
2	exotics (particularly herbaceous) significant and cover may exceed dominant vegetation strata (relative cover <66%)	A "haze" *of Schismus* (tawny) or *Bromus rubens* (reddish brown) is uniform in the understory of shrubby or treed overstory, as in degraded *Larrea tridentata* (lacking much *Ambrosia dumosa*), or ochre "haze" of *Brassica* is found in the sandy soil of *Larrea tridentata-Ambrosia dumosa*, or a brown to dark gray signature of *Salsola* is associated with a native woody overstory (e.g., *Suaeda, Atriplex* spp.) in saline or alkaline soils.
3	stand characterized by exotics (vegetation type is "exotic") (relative cover >66%)	The overstory is dominated or characterized by non-native exotics (either woody or herbaceous) without an adequate cover of characteristic native species to define it as a native vegetation type.
9	NA	Exotics is not applicable when the MapUnit is 9300, 9310, 9320, 9800, 9801, 9803, 9804, 9805.

Roadedness: Level of impact by paved and unpaved roads, OHV trails, railroads, etc. Impact is defined by proportion of any polygon of vegetation that is roadless. This has the advantage of helping to identify roadless areas—but the disadvantage of being scale independent. A polygon with a road more or less bisecting it will have a rating of 2, regardless of size; a very large polygon with this rating might still contain a big roadless area. This is broken into the following classes:

Code	Range	Example
0	none visible	
1	low: at least 2/3 (67% to 100%) of the vegetation polygon area is un-roaded by any type of road or OHV track	
2	moderate: between 1/3 and 2/3 (33% to 66%) of the vegetation polygon is intersected by any type of road or OHV track	

3	high: <33% of the vegetation polygon lacks roads of any kind	
9	NA	Roadedness is not applicable when the MapUnit is 9210, 9220, 9300, 9310, 9800, 9801, 9803, 9804, 9805, 9320 (non OHV).

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.), the removal of which could result in a vegetation stand that would otherwise be in very good to pristine ecological condition.

Code	Range	Example
0	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.
9	NA	Development is not applicable when the MapUnit is 9210, 9220, 9801.

AnthropogenicAlteration: 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
0	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.

Code	Range	Example
3	>66% of polygon affected	A vegetation polygon has >2/3 visible effects of clearing, prior agricultural or other effects.
9	NA	Anthropogenic alteration is not applicable when the MapUnit is 9801.

HydroModifier (yes/no): Is the vegetation stand modified by a hydrologic impediment? This is used to tag 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.

Notes: Text field for additional information.

LandUse: If a polygon is either designated as a water or land use type (MapUnit >9000) or the polygon represents a stand with sub-mmu land use area within it, then a land use code is assigned to the polygon. See Appendix D for further information.

Land use code	Description
0	Not Assigned, Not Assessed
1000	Urban
1436	Water Transfer
2100	Non-woody row and field crops
2200	Orchards and Vineyards
9800	Undifferentiated water
9810	Water Impoundment Feature

MethodID: For areas that were mapped by CDFG (see Mappers field below), this field identifies what type of field data (if any were available) supported the vegetation type decision for that polygon. Some of the stands were assessed from a distance using a compass, laser rangefinder, binoculars, and occasionally a spotting scope. For reconnaissance, multiple stands were often assessed from a single location. [MethodID is currently filled in only for areas delineated by CDFG.]

Method Code	Description
1	Rapid Assessment (current project)
2	Releve
3	Field Verification or Accuracy Assessment
4	Photo Interpretation
5	Adjacent stand information or photo
6	Reconnaissance (current project)
7	Other information
8	Older plot data
9	Older recon data

Mappers: Indicates whether a polygon was delineated and attributed by Aerial Information Systems (AIS), or the California Department of Fish and Game's Vegetation Classification and Mapping Program (CDFG).

NRFVconfidence: No regional field verification. For areas that were mapped by CDFG (see Mappers field above), this field identifies photo-interpreted polygons in large, contiguous areas that were inaccessible and in which the confidence in correctly identifying the vegetation type was therefore low. These are marked with "low" in this field.

Conservation: The status of a plant community based on rarity and habitat value. This field is based on the interaction between rarity ranking and the site quality attributes assigned to each polygon. State and globally assigned rarity ranks have already been assigned (see vegCAMP website: http://dfg.ca.gov/biogeodata/vegcamp/natural_comm_background.asp and http://dfg.ca.gov/biogeodata/vegcamp/natural_comm_list.asp) and locally estimated rarity within the Mojave and Sonoran desert ecoregions of California (Miles and Goudey 1997) was assigned by the VegCamp team based on relative representation of the vegetation unit within the mapping area. If a vegetation type was considered rare (S3 or lower) in the state, it automatically also received a locally rare code within the mapping area. However, some vegetation types which are common throughout the state could be considered locally rare if they were represented by a relatively small number of mapped occurrences compared to their overall state distribution. These codified rarity levels were then subjected to analysis based on attributes that pertain to the quality of the individual polygons, such as Development, Roadedness, Exotics, and Anthropogenic Alteration. A ranked prioritization system is used to give ratings as defined below.

Conservation	Description
Rare Vegetation Community S1 S2	Communities with a state rarity rank of S1 or S2 are assigned to the highest conservation level.
Locally Rare or Important Vegetation Community High Quality	Communities that have a state rarity rank of S3 or that are identified as locally rare or important, and are relatively undisturbed are assigned to this level. Four disturbance attributes were considered to define "relatively undisturbed." The values for Exotics, Development and Anthropogenic Alterations must all be less than 2. The value for Roadedness must be less than 2 for small polygons (<50 acres) or less than 3 for large polygons (>=50 acres).
Locally Rare or Important Vegetation. Community	Communities that have a state rarity rank of S3 or that are identified as locally rare or important, but do not have the lowest disturbance level are placed in this category.

CalVegName/CalVegCode: A crosswalk to the CalVeg vegetation system. Note that there may be a one-to-many relationship between CalVeg and NVCS. See http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192.

CWHRtype/CWHRcode: A crosswalk to the California Wildlife Habitat Relationships system. Note that there is usually a one-to-many relationship between CWHR and NVCS. See http://www.dfg.ca.gov/biogeodata/cwhr/.

GlobalRank/StateRank: The global/state rarity rank of the plant community mapped (only for alliances and associations).

Global Rank	State Rank	Description
G1	S1	There are fewer than 6 viable occurrences and/or less than 2000 acres of the community worldwide/statewide.

Global Rank	State Rank	Description
G2	S2	There are 6-20 viable occurrences and/or 2000-10,000 acres of the community worldwide/statewide.
G3	S3	There are 21-100 viable occurrences and/or 10,000-50,000 acres of the community worldwide/statewide.
G4	S4	There more than 100 viable occurrences and/or greater than 50,000 acres of the community worldwide/statewide.
G5	S5	The community is demonstrably secure due to secure worldwide and statewide abundance.

CACode: California Natural Community Codes - unique code assigned to alliances and associations.

NVSMG: The standardized name for the macrogroup within the National Vegetation Classification System. See http://biology.usgs.gov/npsveg/nvcs.html.

EcologicalSystems: A classification system used to create the Gap map for California. They are "groups of plant community types that tend to co-occur within landscapes with similar ecological processes, substrates and/or environmental gradients" (Comer et al. 2003). See http://www.natureserve.org/library/usEcologicalsystems.pdf and http://gapanalysis.usgs.gov/gaplandcover/vision/.

UID: Unique identifier for each polygon

Acres and Hectares: GIS-calculated area measurements of each mapped polygon.

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Appendix A

Rapid Assessment Field Form & 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:

CNPS 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 MCV 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

Classification Hierarchy

Classification Hierarchy
6-27-2012

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
- 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)
- 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 MG034
- 1510* = Vancouverian riparian deciduous forest Group
  - 1511* = *Alnus rhombifolia* (White alder groves) Forest Alliance

*** = 1acre MMU ** = 2.5acre MMU**

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* (Narrowleaf goldenbush scrub) Provisional 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 sandaster scrub)

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

*** = 1acre MMU ** = 2.5acre MMU**

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 Stands
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 Macrogoup 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 Macrogoup MG073
3410* = Arid West freshwater emergent marsh Group
3411* = *Phragmites australis* (Common reed marshes) Alliance
3412* = *Schoenoplectus* spp. (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

*** = 1acre MMU ** = 2.5acre MMU**

3714 = *Juncus cooperi* (Cooper's rush marsh) Alliance
3715 = *Schoenoplectus americanus* (American bulrush marsh) Alliance

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) 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 burr sage 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)
4123 = *Brickellia desertorum* (Desert brickellbush scrub) Alliance

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

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) Provisional wash scrub
4216 = *Ambrosia salsola* (Cheesebush scrub) Alliance
4217* = *Artemisia tridentata* spp. parishii (Parish's sagebrush) Provisional Alliance

4220* = Sonoran-Coloradan semi-desert wash woodland/scrub
4221* = *Pluchea sericea* (Arrow weed thickets) Alliance
4222* = *Prosopis glandulosa* (Mesquite bosque, mesquite thicket) Alliance
4223* = *Prosopis pubescens* (Screwbean mesquite bosques) Alliance
4224* = *Chilopsis linearis* (Desert willow woodland)
4225* = *Psorothamnus spinosus* (Smoke tree woodland)
4226* = *Acacia greggii* (Catclaw acacia thorn scrub)
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

*** = 1acre MMU ** = 2.5acre MMU**

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 jointfir) Alliance
  - 5414 = *Lycium andersonii* (Anderson's boxthorn scrub) Alliance
  - 5415 = *Salazaria mexicana* (Bladder sage scrub)
  - 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)
  - 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 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

*** = 1acre MMU ** = 2.5acre MMU**

6116* = Sparsely vegetated playa (Ephemeral annuals) Mapping Unit
6117 = Desert pavement Mapping Unit
6118 = *Peucephyllum schottii* (Desert fir) Alliance
6119 = *Geraea canescens-Chorizanthe rigida* (Desert gold-Spiny herb) Mapping Unit
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) Alliance

9000 = MISCELLANEOUS CLASSES

9200 = Agriculture (within the current 5-year cycle) (includes nurseries)
9210** = Woody Agriculture (orchards, vineyards)
9220** = Row 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 Ponds and Natural Lakes
9804* = California Aqueduct (Open Water)
9805** = Water Impoundment Feature

*** = 1acre MMU ** = 2.5acre MMU**

Appendix C

Hierarchical Field and Mapping Key

Hierarchical Field and Mapping Key to the 2012 DRECP Vegetation Map

This key is developed for areas mapped between February 2011 and July 2012 in the Desert Renewable Energy Conservation Plan (DRECP) footprint (Figure 1). It only includes those areas of the planning area and 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 includes 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 (please read prior to use):

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 DRECP mapping project has a variable Minimum Mapping Unit (MMU) size. For fine scale features such as wetlands, riparian, or playas it is 0.4 ha (1 ac) and for upland vegetation it is 4 ha (10 ac). Certain types of upland vegetation are only found in washes (*e.g.*, associations of *Larrea tridentata* alliance with *Ambrosia salsola*, or *Atriplex polycarpa* alliance). In these cases, these vegetation types are mapped at a MMU of 1 ha (2.5 ac) in order to maintain the wash vegetation features separate from surrounding upland. Special types are mapped to 0.4 ha (1 ac). The foothills of the Transverse Ranges are mapped to 1 ha (2.5 ac), as are land use polygons, in keeping with state-wide mapping standards.

Alliance: Plant communities based on dominant/diagnostic species of uppermost or dominant stratum. Part of the United States National Vegetation Classification (USNVC) 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 USNVC 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. Although rules within the Mojave-Sonoran desert may discuss *Yucca brevifolia* having a threshold membership rule of >1% cover, evenly distributed, when *Y. brevifolia* occurs over a much more dense and evenly distributed sclerophyllous shrub cover of *Adenostoma fasciculatum* or *Quercus john-tuckeri*, that rule does not apply and that stand would key to the best characteristic species of the shrub layer. 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 USNVC 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 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 are compatible with the key and 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.

Significant: A species which has 1 to 5 percent absolute cover.

Important: A species or species group with >1 percent absolute cover. A species is considered important if it has greater than 1 percent absolute cover. This term is contrasted with dominant to mean that the species is always present in greater than 1 percent cover but not always dominant. All significant species are therefore, important, but species with higher importance may also be codominant or dominant.

Sparse: Used to describe individual layers of vegetation (tree, shrub, herb, or subdivisions of them) where the cover is 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 USNVC, 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 cover of trees > 60%, but individual stands under certain conditions may drop lower than 60 percent.

Woodland: In the USNVC, 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.

Sparsely wooded: These are stands with conspicuous trees at generally at least 10% absolute cover but less than 25 percent cover, and may occur over shrubs as the dominant canopy (sparsely wooded shrubland) or herbaceous cover (sparsely wooded herbaceous).

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.

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 that 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. Even at 5% absolute cover they define the stands, 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 less than 0.5 meter tall.

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: Note that we use the NRCS PLANTS database in vegetation mapping as our standard for botanical names. [In the Final version of this report, users of the Jepson Manual 2nd Edition (Baldwin et al 2012) will find a list of name changes at the end of this key].

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 et al. 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 Dammed Ponds and Natural 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 (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 = Row 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

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 SEMINATURAL 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*)…

3*. Dicoria canescens* or *Abronia villosa* are characteristically present in stands, but are not necessarily dominants, 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 and uniform woody plant cover is < 2% absolute cover…
6121 = *Dicoria canescens - Abronia villosa* (Desert dunes) Alliance

3'. *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*. 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)

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* > 1% cover and 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" (mostly < 2% shrub cover). However, some stands can have up to 10% shrub cover under certain circumstances. Stands that are codominated 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

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 even 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…

11. Extremely sparse, dark, and unvegetated to a large degree even in good rainfall years, photo signature is usually distinctive and often looks like asphalt pavement. No evenly spaced shrubs are present. Look for evidence of old dark alluvial surfaces with no shrub cover and gradual to moderate slopes. If the slopes are steep, choose 6115 and if highly dissected and fine-textured choose 6113. Best examples are in the eastern part of the mapping area where these are extensive and diagnostic of this part of the Colorado Desert. Farther west the rainfall average is higher and the quality and extent of this landform are less pronounced. Good examples occur adjacent to Pinto Basin and some also occur in Dale Lake basin. Modeling for mapping suggests using this mapping unit only in the driest part of the mapping area, generally east of the longitude of Barstow and Lucerne Valley…
6117 = Desert pavement Mapping Unit

11'. Surfaces usually have evidence of some herbaceous cover with the indicator herbs *Chorizanthe rigida*, and/or *Geraea canescens* either as residual skeletons or in good rainfall years visually obvious displays characterized by these native annuals. Moving westward from the eastern portions of the mapping project, old alluvial surfaces tend to be better vegetated. Those that resist shrub colonization tend to at least have good stands of *Geraea canescens-Chorizanthe rigida* and sometimes other annuals in good El Niño years. Stands that have other types of herbaceous vegetation including *Lasthenia gracilis, Amsinckia* spp., or non-native annual herbs such as *Bromus rubens* should be mapped to their respective alliances or semi-natural stands and not as desert pavement or this alliance...
6119 = *Geraea canescens-Chorizanthe* rigida (Desert gold-Spiny herb) Provisional 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…

12. This mapping unit is usually sparsely vegetated 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

12'. 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.

13. 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.*, > 3 m 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

14. 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 (M036 Warm Mediterranean & Desert Riparian, Flooded & Swamp Forest)

15. 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

16. *Populus fremontii* is dominant or codominant 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 codominated by tree willows such as *Salix gooddingii* or *S. laevigata* will key here. *P. fremontii* > 5%, *Platanus*, *Salix laevigata*, each usually < 5%; *S. gooddingii* may be codominant, shrubby *Salix lasiolepis*, *S. exigua*, or *Baccharis* spp. may be present at low to high cover in the understory…

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

16'. *Populus fremontii* is not dominant or codominant...

17. *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 codominant 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

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

18. *Salix gooddingii* is the strongly dominant tree, while other tall woody shrubs may be subdominant*. S. gooddingii* > trace; 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

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

19. *Platanus* racemosa is characteristic of the riparian tree canopy. *Platanus racemosa* > trace; 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

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

20. 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 codominant. 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

20'. *Alnus rhombifolia* is present and evenly distributed in the riparian tree layer. If *Platanus* 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 (M034 Rocky Mountain & Great Basin Flooded & Swamp Forest)
1510 = Vancouverian riparian deciduous forest Group
1511 = *Alnus rhombifolia* (White alder groves) Forest Alliance

15'. 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…

21. Native species of *Baccharis* spp*., Sambucus, Forestiera*, *Salix exigua* or *S. lasiolepis* are dominant or codominant*. 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

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

Baccharis emoryi 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

Shrublands characterized by the dominance of *Baccharis salicifolia* usually > 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

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

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

Salix lasiolepis relative cover is over 50% and no other willows are dominant or subdominant. 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. *S. lasiolepis* > trace; if present, *S. laevigata* < *S. lasiolepis and P. racemosa, Populus spp.,* and *S. gooddingii* all trace…

1427 = *Salix lasiolepis* (Arroyo willow thickets)

Salix exigua is characteristically present as a dominant or codominant shrub with >5% cover. 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. *Salix exigua* dominates stands (> 50% relative cover in shrub layer)…
1424 = *Salix exigua* (Sandbar willow thickets) Alliance

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

Forestiera pubescens is the dominant shrub species in the canopy, usually occurs 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

21'. 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)…

24. *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

24'. Vegetation strongly dominated (>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 to be considered as alliance. *T. aphylla* (Athyl) trees are usually not invasive and remain in their originally planted arrangement (hortomorphic)…
1432 = *Tamarix* spp. (Tamarisk thickets) Semi-natural Stands

14'. 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…

25. 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

26. 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

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

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

Quercus wislizeni is dominant or codominant at >30% relative cover, with other tree species in the 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

27'. Broad-leaf trees other than oaks are dominant or codominant (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

Aesculus californica is dominant (>60% relative cover) as a tree or tall shrub in the overstory. If buckeye is codominant 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

26'. 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 it is generally >10%. Stands identifiable as the alliance occur largely over herbaceous or mixed shrub and herb understories. Stands 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* present and evenly distributed, it is no more than 30% relative cover (or if *J. californica* > 10% absolute cover, then *Y. brevifolia* no more than 4 % absolute cover) in the tree or tall shrub layer. In other words, when *Yucca brevifolia* is present, *Juniperus* must be 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 (*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

25'. 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* codominant, which may be up to 3 x 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 (new name: 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 codominance 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 codominant). If *Juniperus californica* is present, *Juniperus* must have > 3x as much absolute cover as *Pinus monophylla* (which takes precedence when codominant)…

1300 = Intermountain Basins Pinyon-Juniper Woodland Macrogroup MG026 (new name: M026 Intermountain Singleleaf Pinyon - Western Juniper Woodland)

1310 = Western Great Basin montane conifer woodland Group

1311 = *Pinus monophylla* (Singleleaf pinyon woodland) Alliance

13'. 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 (2 to 5 m tall) with a closed canopy, to < 1 m 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 codominance of drought-deciduous *Salvia mellifera*. This shrubland group includes chaparral typically located inland from maritime chaparral from sea level up to 2000 m (6400 feet) 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 dominant or codominant (two choices below)…

A*denostoma fasciculatum* occurs as a dominant, or as a codominant with *Eriogonum fasciculatum* or other shrubs such as *Eriodictyon crassifolium* or *E. trichocalyx*. If codominant 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 codominant (three choices below)…

Arctostaphylos glauca is the dominant or codominant 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 codominant with other chaparral shrubs in lower numbers (*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 codominated 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 2000 m, 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 codominant 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 codominant. 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 1500 m (4550 feet) in elevation and up to 1830 m (6000 feet) 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 codominance of *Adenostoma fasciculatum* (two choices below)…

Quercus berberidifolia usually occurs as a dominant or, if it codominates, 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 codominates with *Adenostoma fasciculatum* (*Adenostoma fasciculatum* and *Quercus berberidifolia* each greater than 15% relative cover in the shrub layer), other shrubs in the stands are significantly less cover. Only in Cajon Pass and Pine Creek area…
2133 = *Quercus berberidifolia – Adenostoma fasciculatum*

(Scrub oak-chamise chaparral) Alliance

35’. Chaparral shrubs other than *Quercus berberidifolia* or *Adenostoma* dominant or codominant (two choices below)…

Cercocarpus montanus > 30% relative cover with no other shrub species exceeding it in cover, or *C. montanus* and *Arctostaphylos glauca* with equal relative cover (Keeler-Wolf et al. 1998b). Both *C. montanus* and *Eriogonum fasciculatum* between 30% and 60% relative cover in the shrub canopy. 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 *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 codominated by *Prunus ilicifolia*. *Heteromeles arbutifolia* may be codominant. If *Quercus john-tuckeri* codominates, 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 1500 m (5000 feet) 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 codominated by the following species: *Gutierrezia californica, Lotus scoparius, Lupinus albifrons, Ericameria linearifolia,* or a species of *Eriodictyon.*

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

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

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

Ericameria linearifolia is dominant to codominant 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* (Narrowleaf goldenbush scrub) Provisional Alliance

An *Eriodictyon* species dominates. 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

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 codominated 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)

Corethrogyne filaginifolia dominates recently burned margins of chaparral or coastal sage scrub in the foothill regions of the Western Mojave Desert. Small sub-MMU stands occur in the vicinity of Cajon Pass and the northern Liebre Mountains foothills…
2218 = *Corethrogyne filaginifolia* (Common sandaster scrub) 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

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

Eriogonum fasciculatum ≥ 2% absolute cover or >50% relative cover in the shrub canopy; other shrubs if present < half its cover, but *Hyptis emoryi* or *Salvia dorrii* may be higher (Thomas et al. 2004). 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 codominate with many species. Instead they are often single dominant stands. In the desert hills and mountains > 1000 m (3000 ft) 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. 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 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

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 codominant 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 codominant on fine-textured, moderate to steep slopes, or *Coreopsis calliopsidea* is the dominant annual herb with < 2% absolute shrub cover (shrubs not evenly distributed and < 2%), forming bright golden-yellow seasonal patches on fine textured soils in the West Mojave (especially the area around Four Corners)… *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 springtimes of 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 with usually a number of native and non native annuals present…
2320 = California perennial grassland Group

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

Provisional Alliance (not mapped and not inventoried in study area)

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* or *B. tournefortii* are the most prevalent dominant species (where shrubs < 2% absolute cover and not evenly distributed). Usually on sandy substrates, often near road cuts or in clearings, fallow fields, large washes, riverbeds, etc. Stands can include *Sisymbrium irio* and other species as the local dominants. *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

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)
No stands seen in any recons of the 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…
3111 = *Bromus tectorum* (Cheatgrass grassland) Semi-natural Stands

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 codominant with non native annuals.
3120 = Western dry upland perennial grassland Group

Poa secunda is dominant or codominant 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 other herbs. Sole member of this group in the mapping area is *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 probably also large stands nearby (need field verification). If *Eschscholzia* seen in air photos, always label as *Eschscholzia*, but in other areas that have high natives and no obvious wildflower fields, might expect this alliance 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

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…Sole member locally is *Ribes quercetorum* alliance
3200 = Western Cordilleran Montane Shrubland and Grassland Macrogoup MG049 (M049 Southern Rocky Mountain Montane Grassland & Shrubland)
3210= Western Cordilleran montane deciduous scrub Group (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 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) are 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 or it intermixes as a low tree 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 codominant 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 codominant, 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 codominant 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)

42'. 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 MG 076)
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

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 spp.* (Bulrush) Mapping Unit

3413 = *Schoenoplectus acutus* (Hardstem bulrush marsh) Alliance

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

Typha spp. dominate the stands. 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 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

Muhlenbergia rigens, the mid size tufted perennial grass, characterizes the stands. 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 may contain *Juncus* or *Schoenoplectus* species, but are not dominated by them (four choices below)…

Stands in moist meadows and flats often associated with alkaline water and stands of *Distichlis spicata, Schoenoplectus americanus*, or *Juncus arcticus*. 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…
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 (not mapped and not inventoried in study area)

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 > 2% absolute cover in the shrub canopy and no other species with greater or equal cover (Keeler-Wolf et al. 1998b, Thomas et al. 2004). 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 *Distichlis* understory…
3721 = *Allenrolfea occidentalis* (Iodine bush scrub) Alliance

The annual pickleweed *Salicornia depressa* is the dominant herb. No other species approaching 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 only 2-3 acres on average and 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* (Picklweed flats) Herbaceous Alliance

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 (> 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.* Based on codominance to dominance by *Suaeda moquinii*, key to *Suaeda.* Strong dominance by *A. confertifolia* keys to *Atriplex confertifolia*. For example, Charlton (at Edwards AFB) has a description of a *Suaeda–Atriplex lentiformis* ssp. *torreyi* Shadscale Association...

3722 = *Atriplex lentiformis* (Quailbush scrub) Alliance

Atriplex spinifera (spinescale saltbush) dominates or codominates with *A. polycarpa, Larrea tridentata,* or *Ambrosia dumosa* in the shrub canopy. When *A. confertifolia* is codominant with *A. spinifera,* key to *A. confertifolia.* The herb layer has open to intermittent cover including *Bromus rubens, Erodium cicutarium* and *Lasthenia*. *A. spinifera* prefers fine textured silty or clay soils that aren't 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 occurs with *Artemisia spinescens* and *Lepidium fremontii* near playa lakebeds, where either of these additional species may codominate. 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 codominant), *Atriplex polycarpa*, and *Krascheninnikovia lanata* (*e.g.*, in Four Corners area north to Cuddyback Lake). *Lasthenia gracilis* or *Coreopsis calliopsidea* are often the dominant annual species associated with *Atriplex spinifera*. *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 (non 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 codominant (>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 is ≥2% cover and evenly distributed. No other shrub (or tree) species have greater or equal cover. 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 are often in 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). 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. If *Suaeda moquinii* and either *Atriplex confertifolia* or *A. lentiformis* ssp. *torreyi* codominate, the alliance is *Suaeda*. If *Suaeda moquinii* and *Allenrolfea occidentalis* codominate, the alliance is the latter…

3725 = *Suaeda moquinii* (Bush seepweed scrub) Alliance

Distichlis spicata ≥ 2%, dominant or codominant with >30% relative cover in the herb layer. 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 > 100 m (300 ft) wide for > 4 ha, 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 (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 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* present, they are 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% 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 less than 2% absolute cover. No other shrub has similar or greater cover. 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. When stands are codominated with *Krascheninnikovia lanata, Ericameria cooperi, Tetradymia spp.,* or *Eriogonum fasciculatum* (but not *Grayia spinosa,* or *Atriplex spinifera*), stands are *Ambrosia dumosa* alliance…
4111 = *Ambrosia dumosa* (White bursage scrub) Alliance

54'. *Ambrosia dumosa* may be present, either codominant with, or have less cover than *Atriplex*, *Larrea tridentata, Encelia, Pleuraphis*, or *Cylindropuntia* spp…

55. *Atriplex polycarpa* has the highest shrub cover and covers > 3% of a single stand and makes up > 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 always 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. Stands codominant with *A. spinifera* key to *A. spinifera*…
4113 = *Atriplex polycarpa* (Allscale scrub) Alliance

55'. *Atriplex polycarpa* is not dominant; either *Encelia farinosa, Larrea tridentata* dominant or conspicuous and evenly spaced…

56. *Encelia farinosa* is the pronounced dominant (at least >1%), no other species have equal or higher cover. *Larrea tridentata* is largely absent. *Ambrosia dumosa* and *Fagonia laevis* have been noted as associated species. Occurs 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, 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 the sole dominant. If present, it is codominant with *Larrea tridentata* or subdominant to absent with other shrubs…

57. *Larrea tridentata* and *Encelia farinosa* are both present and in similar cover (broadly codominant), although sometimes *E. farinosa* < 1% cover, but if so, then *A. dumosa* also very low cover or absent. *Larrea tridentata, Encelia farinosa,* and sometimes *Ambrosia dumosa* codominate, sometimes along with these other conspicuous or codominant 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 codominant. 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 codominant with *Ambrosia dumosa*, or is the sole indicator, either mixing with other shrubs (not *Ambrosia dumosa* or *Encelia farinosa*) or as the sole dominant shrub. *Yucca* species are generally less than 1% and not evenly distributed…

59. *Larrea tridentata* is broadly codominant with *Ambrosia dumosa* and both species are evenly distributed across the stand and in combination the two species (if covers added) clearly dominate. 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* conspicuously present (≥1 % cover) as short shrub between evenly spaced *Larrea*; may have higher cover than *Larrea tridentata*. If *Encelia farinosa* is present it is ≤1% cover. *Yucca schidigera* if present is < 1% cover or is unevenly distributed (see *Yucca schidigera* alliance if higher cover and evenly distributed). *Atriplex polycarpa* can be codominant. Widespread on all but the hottest, rockiest, sandy, or alkaline areas of the middle and lower elevations. Do not expect *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* alliance rather than *Larrea tridentata – Ambrosia dumosa*. Tends to occur on north-facing slopes at the lowest and hottest exposures, where south-facing would be *Larrea tridentata – Encelia farinosa* or *Encelia farinosa*. Only occurs on shadier north-facing exposures in the Colorado Desert, where extremely dry…
4115 = *Larrea tridentata* – *Ambrosia dumosa* (Creosote bush - white burr sage scrub) Alliance

59'. *Larrea tridentata* is the dominant shrub with at least 2% cover and is evenly distributed in the stand. Associated shrubs other than *Ambrosia dumosa* or *Encelia farinosa* may be present or absent (*e.g.*, *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. Stands inventoried east of this area occur on sand

ramps and dune aprons in hot and very dry locations tending to have < 5% perennial cover. No mapped polygons in our area…
121 = *Tidestromia oblongifolia* (Arizona honey sweet sparse scrub) Provisional Alliance

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

61. The shrubby grass *Pleuraphis rigida*, is the dominant perennial species although may occur with scattered shrubs of *Larrea, Ambrosia dumosa, Ephedra trifurca,* or other shrub species. Stands are on sand ramps, dune aprons, stabilized dunes near playas, or wide washes adjacent to *Larrea tridentata – Ambrosia dumosa* stands. Stands are often mixed with lower cover of *Larrea, Ambrosia*, or other shrubs. Sandy stands adjacent to freeways and disturbance often have a significant non-native component of *Brassica tournefortii, Schismus* spp, etc.

Pleuraphis rigida is dominant and can be considered in the same layer as commonly occurring

shrubs (*e.g.*, *Larrea, Atriplex*). Stands not often separable from *Larrea – Ambrosia dumosa* (really *Larrea-Ambrosia dumosa* / *Pleuraphis rigida* association), but may occasionally be large enough to map in the far eastern portion of map area; western-most occurrence 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 codominated 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. No other species with greater or equal cover. On northerly slopes of

the Mojave and Sonoran Desert in California. Found just above *Larrea tridentata – Ambrosia dumosa* alliance or in washes in east Mojave Desert. Generally at higher edge of *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 codominate with several of the above listed shrub species…
4151 = *Viguiera parishii* (Parish's goldeneye scrub)

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 and on boulders, often recently burned slopes (grass carries the fires up into the rocks)…
4123 = *Brickellia desertorum* (Desert brickellbush scrub) Alliance

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

63. Vegetation either dominated or codominated by *Ephedra californica Ephedra trifurca, Senna armata,* or *Brickellia incana.. 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…
4211 = *Ephedra californica* (California joint fir scrub) Alliance

63' Vegetation not dominated or-codominated 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. (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,* or *Artemisia tridentata* ssp. *parishii* (five choices below)...

Ambrosia salsola is strongly dominant (> 60% relative cover in dominant shrub layer). Stands of washes or disturbed uplands. Upland stands are usually associated with fire, clearing, or other disturbance in former *Larrea-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. *A. 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). Stands in washes must be > 5 acres in order to map. If they are smaller, map with 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 ≥ 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 must be > 2 x the cover of it to make this alliance. If adjacent to *Chilopsis linearis* stands and with lower extent, subsume these stands into *Chilopsis* map polygon…
4213 = *Ericameria paniculata* (Blackstem rabbitbrush) Alliance

Prunus fasciculata ≥ 2 percent 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, 3000 ft) 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 in hills northwest of 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 polycarpa, Ericameria nauseosa,* or *Atriplex confertifolia*, and may have emergent *Forestiera or Prosopis* at low cover or widely scattered. Small, usually linear stands associated with low gradient channels and washes in 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…
4217 = *Artemisia tridentata* spp*. parishii* (Parish's sagebrush) Provisional Alliance

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 > 3% absolute cover as the dominant plant (including shrub and trees together), not exceeded in cover by any other species of microphyllous tall shrub or tree. Usually associated with stabilized dunes or sand sheets adjacent to playas or basins. Mapped even if very low cover, especially if evidence of recent die-off due to dewatering via ground pumping, etc. Stands along Mojave River near Daggett-Yermo are almost completely dead, but are mapped if possible...
4222 = *Prosopis glandulosa* (Mesquite bosque, mesquite thicket) Alliance

Prosopis pubescens stands are sporadic and 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. Not expected to be mapped unless field verification available. Only large stands seen have been along Colorado River in Colorado River Indian Reservation…
4223 = *Prosopis pubescens* (Screwbean mesquite bosques) Alliance

Stands characterized (1% or higher cover) by *Chilopsis linearis* no other tree-size or tall shrub species equals or exceeds *Chilopsis linearis* cover. *Chilopsis* is usually 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 mountain valleys and narrow arroyos as much as the *Acacia greggii* or *Prunus fasciculata* shrublands, and does not tend to occupy the most active wash centers such as do *Psorothamnus spinosus, Ericameria paniculata, or Ambrosia salsola* shrublands...
4224 = *Chilopsis linearis* (Desert willow woodland)

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 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)

Olneya tesota and *Parkinsonia florida* occur together or on their own at usually greater than 2% cover (including both shrub and tree layers). Associated species may include *Larrea tridentata* and *Ambrosia salsola*, and they may be similar in 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 including *Acacia greggii*, *Pluchea sericea*, or *Hyptis emoryi* visually prominent (may be as low as 2% cover) 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, these 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 have 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 > 2% cover. No other single tall shrub species had greater cover, but *Prunus fasciculata* or *Hyptis emoryi* may be equal or slightly greater cover than *Acacia.* Smaller shrubs such as *Ericameria paniculata* 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 bouldery slopes. Proliferates after disturbance including flood and fire. Found in Ord Mountains and as far west as the north slope of Sidewinder Mountain into area of our study and also in eastern portion near Twentynine Palms…
4226 = *Acacia greggii* (Catclaw acacia thorn scrub)

Vegetation characterized (≥2%) by *Hyptis emoryi*. Other shrub species are not in high cover, but 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 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 *Yucca brevifolia* and *Yucca schidigera* alliances.

Stands include long persisting woody species but also commonly include species that colonize readily and rapidly when conditions are met. *Ericameria* is a particularly diagnostic genus (except *E. paniculata*). *Atriplex confertifolia* and *A canescens* are both placed in 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 common and diagnostic: *Atriplex canescens, A. confertifolia, Artemisia tridentata* (various subspecies), *Ericameria cooperi, E. nauseosa, Encelia actoni* , *Ambrosia salsola*, and *Gutierrezia microcephala...*

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

Atriplex canescens has the highest shrub 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 (3000 ft) 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. c*. 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 has the highest shrub cover. 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). When codominant 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*. When *Atriplex spinifera* and/or *Artemisia spinescens* are codominant with *A. confertifolia* on playa edges (as at Edwards Air Force Base) stands key to *A. confertifolia* alliance...
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
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 not characterized by *Atriplex canescens, A. confertifolia* or *Sarcobatus*. 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. Dominant plants are relatively small, short-lived plants that colonize uplands following natural or unnatural disturbance such as clearing or fire. The main species are members of the genera *Ericameria.* Other common diagnostics in our area include *Encelia actoni* or *Ambrosia salsola*. *Eriogonum fasciculatum,* especially ssp. *polifolium* also occurs in such settings, especially in codominance with other species in this group, as well as *Ephedra nevadensis, Thamnosma montana*, and *Tetradymia* sp.
5210 = Intermontane seral shrubland Group
(four choices below)...

Encelia 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 has ≥ 2% absolute and ≥ 25% relative cover. 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. Particularly abundant on the margins of the Liebre, Tehachapi, and Sierra Nevada mountains and also abundant off alkali soils in 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. Stand shows evidence of recent disturbance (typically fire) and is usually adjacent to stands with larger and longer-lived shrubs more easily keyed to *Grayia spinosa, Ericameria teretifolia, Coleogyne ramosissima,* or *Larrea tridentata – Ambrosia dumosa*.
This is highly provisional based on strong dominance (generally > 60% relative cover) of *E. cooperi.* This is unusual and most stands with codominant *E. cooperi* can be better placed in *Ambrosia dumosa*, *Grayia spinosa*, or *Ambrosia salsola* alliances. Stands codominated by *E. nauseosa* or *E. teretifolia* key to those alliances respectively. The species occurs commonly in the West Mojave in all sub regions. It is spring flowering and shorter lived and more directly a disturbance responder than *Ericameria teretifolia…*
5215 = *Ericameria cooperi* (Cooper's goldenbush) Provisional Alliance

68'. A subspecies of *Artemisia tridentata* is dominant or codominant 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 codominant. 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 codominance 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 codominant. 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. t.* ssp. *parishii* is at least 30% relative cover and evenly distributed. *A. t.* ssp. *parishii* occurs in finer textured soils more immediately adjacent to swales or intermittent channels than typical stands of *A. tridentata* ssp. *tridentata*. It 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')...
***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 western and central Mojave and Sonoran desert fires and clearing have resulting in a confusion of 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: *Ericameria teretifolia, Coleogyne ramosissima, Grayia spinosa, Purshia tridentata, Salazaria mexicana, Ephedra nevadensis, Yucca schidigera* and *Yucca brevifolia…*
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.* This vegetation merges with the upper edge of the *Larrea tridentata – Ambrosia dumosa* belt and is usually seen on north-facing slopes at lower elevations but will occupy basins and slopes at all elevations above 1050 m (3500 ft). May occur on slopes, but also in 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. 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 appropriate other 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 codominant with *Salazaria, Encelia actoni* and *Ericameria cooperi*, 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 codominant 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. *E. nevadensis* stands are difficult to predict because of their dependence upon fire or fluvial disturbance. Rocky substrate, 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 codominant with *E. nevadensis,* the stand would key to *Eriogonum fasciculatum* (desert version)...
5413 = *Ephedra nevadensis* (Nevada jointfir) Alliance

Ephedra viridis ≥ 2% cover, dominant or codominant with *Ericameria teretifolia* or *Grayia spinosa*. In our area *Ephedra viridis* is dominant or codominant with *Grayia spinosa*, *Salazaria mexicana, Krascheninnikovia lanata, Ericameria cuneatus*, or *Eriogonum fasciculatum*. 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 (> 1800 m, 5900 ft). Associated with steep talus or rock outcrops except at highest elevations, when it can occur on more moderate slopes. Tends to mix with *Grayia spinosa*, *Salazaria mexicana* or with *Ericameria teretifolia* at 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).* (Type not described in Thomas et al. (2004), but 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

Lycium cooperi is dominant and evenly distributed across the stand. Stands may include codominance of

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

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

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

Grayia spinosa ≥ 2% cover, evenly distributed, and no other species with substantially greater cover. Codominance 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. *G. spinosa* alliance stands occupy the transition between warm desert and cool desert vegetation in much of the study area. *G. spinosa* does resprout 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 1000 m (3000 ft) 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

transition 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 *Krascheninnikovia lanata* on calcareous soils; transitioning 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 up-slope. Largest stands occur in Superior Valley, in matrix adjacent to *Atriplex spinifera* on calcium rich soils (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 on shallow caliche or dolomite (?) where stands tend to codominate with *Grayia* and *Tetradymia fasciculatum.* Stands were 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% cover. No other species with greater cover, but can 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 codominant shrub and may occupy shallow rocky post-fire stands associated with *Juniperus californica* or other upland alliances. In our area it is usually found as low cover

shrubland in 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 codominant 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 codominated by *Eriogonum fasciculatum* or *Salazaria mexicana* (two choices below)...

Eriogonum fasciculatum **≥** 2% absolute cover or >50% relative cover in the shrub canopy; other shrubs if present < half its cover, but *Hyptis emoryi* or *Salvia dorrii* may be higher (Thomas et al. 2004) and *Ephedra nevadensis* can be broadly codominant with *Eriogonum fasciculatum*. 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 codominate with many species, instead they are often single dominant stands. In the desert hills and mountains > 1000 m (3000 ft) 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. 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 more evenly distributed than any of the other shrubs...
2221 = *Eriogonum fasciculatum* (California buckwheat scrub) Alliance

Salazaria mexicana > 2% cover. Other shrubs, if present, are each less than half of the cover with the exceptions of *Hyptis emoryi, Senna armata or Salvia dorrii,* which may have higher or equal 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, often commonly occurs with *Ambrosia salsola, Bebbia juncea, Eriogonum fasciculatum* or *Senna armata.* On rocky slopes 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.* 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* 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 codominant 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 equal it in cover. If present with *Yucca schidigera,* that species needs only to be >1% absolute cover and evenly distributed to shift into a *Yucca schidigera* alliance if *Coleogyne* is as much as 3 x the cover of *Yucca schidigera*. If *Coleogyne* >3 x *Yucca schidigera* then it is a *Coleogyne* stand. *Coleogyne* typically dominates stands, but may be exceeded by 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 soil 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. Particularly devastated

are the Stoddard Wells, Fairview Valley, and Ord Mountain areas...
5421 = *Coleogyne ramosissima* (Black brush scrub) Alliance

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

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

Yucca brevifolia present and evenly distributed throughout stand, though usually only between 1 and 5% cover (highest cover may be 10% in clonal stands in the western part of the mapping area), often with substantially higher cover of shorter shrubs or perennial grasses beneath the well-spaced emergent trees. *Y. brevifolia* must be evenly distributed, not scattered and clumped, and must be 1% or greater absolute cover to map alliance stands. It is usually difficult to discern juvenile *Yucca brevifolia* < 3 m 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 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 evenly distributed. At lower elevations may have *Larrea tridentata, Ambrosia dumosa*, and other shrubs at equal or even higher cover. *Yucca brevifolia* is often scattered in tree layer (<1%). At upper elevations *Juniperus californica* may be present (< 2% cover). If *Juniperus* is ≥ 2x the cover of *Yucca schidigera*, then it *is Juniperus californica* Woodland Alliance. If *Coleogyne ramosissima* is conspicuous, *Yucca schidigera* ≥2% cover. On pediments and hillslopes near the upper-elevation range of the alliance, and common on bajadas and moderate to gentle hillslopes at mid-elevations. Predominantly in southeast portion of the study area including Ord Mountains, Stoddard Wells, and Fairview Valley especially...
5424 = *Yucca schidigera* (Mojave yucca scrub)

77'. *Yucca* not important and evenly distributed. Instead, either *Cercocarpus, Purshia, or Menodora*

are conspicuous, dominant, or codominant (three choices below)...

Purshia tridentata ≥ 2% absolute cover and comprises higher relative cover than any other single shrub (but see below). If *Artemisia tridentata* or *Ephedra viridis* are present they have less than 1% cover. Stands are locally represented adjacent to 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 codominant to dominant *P. tridentata* are keyed to *P. tridentata.* Stands in the current study area are often the result of burned *Juniperus californica* stands and resprouting *Purshia*. Exceptions are 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 codominant with *Eriogonum fasciculatum, Encelia actoni,* and *Hesperoyucca whipplei*...
5422 = *Purshia tridentata* (Bitter brush scrub) Alliance

Menodora spinescens ≥ 2% cover, 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 dolomite?) outcrops associated with pediments north of Ord Mountain. Upon further reconnaissance, may be restricted to a single stand in study area...
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 equals or exceeds cover of *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 only two places in the study area: adjacent to *Coleogyne* on limestone on the north slope of the San Bernardino Mountains. These low elevation stands (1400 m, 4600 ft) are likely to 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 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 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 probably gives way to 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 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 ≥ 1500 m (4500 ft) 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 < 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 as an understory rather than the dominant species in a single herb layer...
5432 = *Pleuraphis jamesii* (James' galleta shrub-steppe) Alliance

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 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

Land Use Mapping Criteria

Criteria For Mapping Land Use In the 2012 DRECP Mapping Area

General Rules

Although land use is not considered a "special" vegetation type with a minimum mapping unit (MMU) of 1 acre, the MMU is lowered from the standard 10 acres for upland vegetation to an MMU of ~2.5 acres for all land use types (codes 9000's through 9300 and 9805). Water types 9800, 9801, 9803 and 9804 have a 1 acre MMU and are assigned a land use code in the Land Use layer (land use code = 9800 for these water types).

Note that the study area includes small portions or fringes of the Tehachapi Mountains, Sierra Pelona, San Gabriel Mountains, and San Bernardino Mountains, which technically are not a part of the desert ecoregion, but do transition into it. For the sake of future mapping continuity these fringe "Foothills" areas are mapped at 2.5 acre MMU for vegetation, using Statewide vegetation mapping criteria. The land use in these areas, however, uses the Desert criteria.

VEGETATION CODES (Vegetation Layer ONLY):

9000 = MISCELLANEOUS CLASSES

9200 = Agriculture (within the current 5-year cycle)

A two-tiered coding system (Vegetation type and Land Use) is used. A given polygon can be coded as both a natural vegetation type and a land use type indicating agriculture if the situation warrants a dual code. 2005 through 2010 image sources are used to interpret and code an area as Agriculture or as a natural vegetation type.

Agriculture in the desert may be difficult to map, especially in areas that have historically been farmed. When mapping an area of agriculture, the question becomes, "when should an area no longer be considered agriculture?" Old plow and irrigation marks on land that has not been cultivated in the past 10 to 20 years or longer may still be visible on the current imagery sources, giving the impression that the area may be agriculture. Based on the successional trends of vegetation in a given area, if vegetated with any identifiable vegetation type, other than herbaceous, any area fallow for < 5 years is considered a candidate for vegetation/land use dual coding.

The Agriculture (Ag) polygon boundary is drawn to the largest actively farmed area seen on any of the imagery in the 2005-2010 time span. Using the multiple image sets as a guide to code the agriculture areas may result in polygons coded as Ag that are not photomorphic to the photo signature on the 2010 imagery. For example, if an area was last actively farmed in 2005, but since then was not active, then the Ag polygon is coded based on the 2005 image. However, the Ag delineation is still drawn to the 2010 image base (e.g. following roads, fence lines, etc. that usually appear on both sets of imagery).

In order to be consistent, the following criteria have been set:

a. Land that has been actively farmed within ~5 years is considered agricultural.
   - If the area in question shows signs of **active** agricultural use (*e.g.,* crop irrigation patterns, or other signs of actively managed crops) on any of the image sources, then the area is called Agriculture in the Land Use layer (use either land use code 2100 or 2200).
   - If an area is shown on the 2010 imagery as fallow or weedy but earlier sources (2005-2010) show active agriculture (crops, plowed dirt, etc.), then the area is still mapped as Agriculture (either 9210 or 9220) in the Vegetation layer.
   - Grassy or vacant areas between and at the outer corners of crop circles are left in Ag regardless of the 10 acre mmu. The crop circle areas are mapped as a box, using fence lines or roads as the boundary where possible.

b. If the area appears to be **inactive** agriculture (based on the 2005-2010 imagery) and remains unchanged from image source to image source, then the mapper made the assumption the area is no longer being used for agricultural purposes even though old plow and/or irrigation marks are still visible. Usually the imagery will show a mottled grass or herbaceous signature. Shrubs may be present in varying amounts and distribution.

   Sometimes the signature may appear as a smooth, tan grassy signature, which may be due to previous *Hordeum* plantings or other single grass/grain crop (prior to 2005) that has since been inactive. In this area, the *Hordeum* is currently growing from old seed and not actively maintained. These areas are mapped as grass unless the field data notes otherwise, such as metal irrigation structures present.

c. An **exception** to the 5 year active Ag rule is if the area in question appears to have enough naturally colonizing shrubs to be coded as a vegetated shrub type (on the 2010 imagery), then the Veg layer is coded the appropriate shrub type (e.g., *5212* = Ericameria nauseosa) and the Land Use layer is coded with the appropriate Land Use Agriculture code (e.g. 2100 = Non-woody row & field crops).

d. In rural or agricultural regions, if there is a structure within a mapped unit that meets the 2.5 acre MMU, the polygon is urban (9300 or 9310) even if the structure is Ag related. This includes structures that are associated with dairies, horse ranches or other Ag related uses. If it doesn't meet the 2.5 acre MMU, it is ignored.

e. Agricultural areas within an Urban Window are mapped if they are >10 acres.

One reason the vegetation code-dependent attribute "anthropogenic disturbance" was created is to account for visually obvious, but > 5 years pre-imagery agricultural disturbance (see definition in "mapping attributes with examples" document).

NOTE: Polygons should are not coded with the generic 9200 code but are assigned a more specific 9210 or 9220 code as described below:

9210 = Woody Agriculture (orchards, vineyards)
Corresponding Land Use layer code is 2200.

Defined as showing orchards, vineyards, jojoba farms, etc. within the past 5 year set of imagery (usually from NAIP early summer 2005-early summer 2010). Abandoned orchards remain as 9210 until the trees have actually been removed. If an orchard/vineyard is completely removed based on the 2010 imagery, then the area is mapped as its current (2010) vegetation and/or land use type.

9220 = Non-woody Row and Field Agriculture
Corresponding Land Use layer code is 2100.

Defined as showing as active agriculture at least once within the past 5 year set of imagery (usually from NAIP early summer 2005-early summer 2010).

9300 = Built-up & Urban Disturbance
Corresponding Land Use layer code is 1000.

Settlements – Suburban Areas

Areas of urban development that are below the MMU for Urban Window: MMU for code 9300 is 2.5 acres; MMU for Urban Window (9310) is 1 square mile.

a. Settlements or other developed areas (9300) are not mapped next to an Urban Window (9310). The 9300 is incorporated into the 9310.

b. Vacant areas within a settlement that are disturbed, scraped, or grassy are cut off from the natural vegetation around the settlement and included with the Urban. There is usually a road at the urban break that is used as a polygon boundary.

c. Vacant areas within a settlement or rural residential area that has "natural" vegetation are mapped using the following criteria:
   - A vegetation polygons is pulled out if it is at least 10 acres of contiguous vegetation not split or disrupted by roads or other man-made features.
   - If the vegetated area meets the 10 acre unsplit (by roads) MMU then other vegetated areas adjacent to the "main" unit but split by roads are added to the vegetation polygon.
   - "Snaky" vegetation polygons are not created just to meet the 10 acre MMU.
   - This rule applies to areas that are "more built-up" (settlements) and does not apply to "more natural" areas that are just split by multiple roads.

d. Non built-up "holes" within the settlement that are scraped or otherwise disturbed are left as part of the Urban built up (9300) polygon.

e. Natural vegetation that comes into the settlement from the outside is continued into the Urban area as a natural vegetation type if the natural area meets the 10 acre MMU. This linework can either be straight or more natural looking. When the natural vegetation is riparian, the MMU is lowered to 1 acre to maintain continuity.

f. If all the vegetation within the urban settlement is >10% natural then it is coded as a vegetation type in the Vegetation layer, with the Land Use code of Urban (1000) in the Land Use layer.

   Scraped lots and any urban built up areas <1ac adjacent to urban are included in the urban polygon. Context is used for this guideline - scraped areas may not always get mapped into the land use, especially if the scrapings are linear along a roadway or fence.

g. If an area is under construction (including buildings or cleared land with an urban development footprint), it is coded as 9300. This includes under construction areas that are adjacent to existing land uses such as residential developments as well as areas that are isolated.

h. Cleared areas on horse-related property that may be dirt or grass (looks green in most cases) are coded as 9300 (no dual coding for veg and land use).

i. Flood Control Basins – are included in the 9300 polygon but are mapped separately as a 9805 if >10 acres.

Military Target Areas
Cleared areas that are on the DRG as "target" are coded as 9300 in the Veg. These have been mapped on Edwards Air Force Base. Additionally, areas that are maintained as cleared areas are also coded as 9300.

Isolated Built-up Areas (9300) vs. Natural Vegetation PI Code
Isolated built-up areas not associated with an urban window or settlement/ suburban area are typically more rural in character, and can range from one isolated homestead to a group of houses on large lots mixed with vacant lots, small agricultural plots, and pods of natural vegetation.

a. If Natural vegetation is <10% the entire area is coded as 9300. This polygon would get a Land Use layer value of 1000.

b. If Natural vegetation is >10% the entire area is coded as a natural vegetation type in the Veg code and a Land Use layer value of 1000.

Miscellaneous Considerations

a. Photointerpreters were instructed to try to keep the polygon delineation tight to the land use and associated land use disturbance by pulling out as much natural vegetation without land use as possible.

b. If there is a large area (at least 2.5 acres) of disturbance (scraped land) with very little to no development, it is mapped as a vegetation code of 9320 with Anthropogenically Altered Disturbance = 3.

c. Major four-lane divided highways and freeways, such as State Highways 14 and 58, and Interstates 15 and 40 are pulled out to the fenced right-of-way as Urban. Vegetation within it is not pulled out separately.

    i. If the right-of-way (ROW) falls below the 2.5 acre mmu width (1/2 the width of a 2.5 acre box), that portion of the highway is not mapped unless it is a very short segment, thus keeping the roadway connectivity intact.
    ii. Typically the type of vegetation within the ROW is a disturbance type of vegetation and is different from the natural type of vegetation outside of the ROW. In this case, the ROW boundary is used and the disturbance vegetation in the road polygon is included.
    iii. The exception to this is when the ROW extends beyond 90’ past the pavement edge, when the disturbance corridor is reevaluated and the ROW boundary may not be used as the road boundary.
    iv. Lines are not drawn between the same type of vegetation based on a ROW fence line. The vegetation is kept together in one poly and the road in a different poly where possible.

d. Active quarries are mapped as 9300 (the Land Use layer attribute will be coded as Urban = 1000). Vegetated areas within an active mine operation are included.

e. Underground mines are mapped as natural vegetation with no land use coding. The mapper can code for Anthropogenically Altered Disturbance level 1, 2 or 3 depending on surficial disturbance visible on images.

f. Inactive quarries, usually where vegetation has been reestablished, are dual coded with a natural vegetation type, an Anthropogenically Altered Disturbance code of 1, 2, or 3, and a Land Use layer value of 1000.

9310 = Urban Window

a. Fully developed contiguous area of built up and disturbed lands greater than 1 square mile in size are considered the Urban Window.

b. Urban/disturbed polygon (9300) are not mapped next to an Urban Window, but are incorporated into the 9310.

c. If an urban area is smaller than 1 square mile, it is mapped as a 9300.

d. If an area is within the Urban Window and under construction (including buildings or cleared land with an urban development footprint), it is coded as part of the 9310. This includes under construction areas that are adjacent to existing land uses such as residential developments and areas that are isolated.

e. Agricultural areas are only mapped within an Urban Window if they are >10 acres. However, agricultural areas along the edge of an Urban Window adhere to the 2.5 acre MMU rule.

f. Vacant areas within an Urban Window that are "natural" vegetation are mapped as vegetation polygons if they are at least 10 acres of contiguous vegetation not split or disrupted by roads or other man-made features.

g. If the vegetated area meets the 10 acre (unsplit by roads) MMU then other vegetated areas adjacent to the "main" vegetation unit but split by roads are added to the vegetation polygon. The minimum mapping width (MMW) for a 10 acre MMU polygon is 333 feet, approximately half the width of a 10 acre MMU square.

h. Natural vegetation that comes into the settlement from the outside is continued into the Urban area as a natural vegetation type if the natural area meets the 10 acre MMU and MMW. This linework can either be straight or more natural looking.

i. Snaky vegetation polygons are not created just to meet the 10 acre MMU.

j. Cleared areas on horse-related property that may be dirt or grass (looks green in most cases) will be coded as 9300 (no dual coding for veg and land use).

k. Flood Control Basins – are included in the 9310 polygon but are mapped separately as a 9805 if >10 acres.

l. An exception to the Urban Window criteria of not dual coding an urban window polygon is in the Piñon Hills region of the study area. In this situation, the natural vegetation is composed of a fairly large dense and continuous (non disjunct) cover of California Juniper, Joshua Trees, and Pinyon Pine overlapping the urban window polygon. In order not to lose this continuous overstory of natural vegetation, this area has dual coding of the vegetation and land use within the urban window polygon.

9320 = Anthropogenic areas of little or no vegetation
Isolated scrapes with no apparent built up uses associated with them that are >2.5 acres are mapped as 9320 with an Anthropogenic Disturbance of 3.

Intensely used OHV areas where the vegetation may have been removed because of high vehicle traffic are not considered a 9320. However, cleared or scraped OHV staging areas used for camping or rendezvous are considered 9320. For these situations, a Roadedness Disturbance a value of 3 and the Anthropogenically Altered Disturbance a value of 0 are assigned.

a. Isolated scraped land and urban built up areas <2.5 acres are ignored. These visible patterns, when < 2.5 acres, are treated within the vegetation polygon by using the anthropogenic disturbance rating or the development rating (both 0 to 3 scales).
b. When scraped land abuts an urban polygon (9300 or 9310) and is >2.5 acres, it is mapped as part of the 9300/ 9310 polygon.
c. When scraped land abuts an urban polygon (9300 or 9310) and is <2.5 acres, discretion about how it is mapped is left up to the mapper.

9500 = Exotic Trees
A variety of non-native tree plantings occur in the study area. They are associated with human habitation but not mapped as part of a 9300 or 9310 polygon. These are considered "hortomorphic" as opposed to "agromorphic" classes in the National Vegetation Classification. The exotics that are not mapped as this code are:

1431- *Arundo donax*

1432- *Tamarix spp* (not *T. aphylla*)
9501- Eucalyptus

9501 = Eucalyptus
As a genus, Eucalyptus is widely planted and has some unique habitat values. It can usually be distinguished from other exotic plantings, hence the separate coding. No escaped, self-sustaining stands occur in the mapping area, so Eucalyptus is always considered as a sub-category of exotic trees.

9502 = Tamarix aphylla (athel)
Planted *Tamarix aphylla* (athel) should be considered in this category.
This type has a MMU = 1 acre.

9800 = Water
Artificially created water is mapped in the Vegetation layer as Water (9800) and is coded as 9800 in the Land Use field.

The boundary of a water polygon is determined considering the following items:

a. A review all the available imagery and topographic layers
b. The high water line is used
c. The water signature is not cut
d. The best delineation that represents all the imagery is used

- 1ac MMU; 10ac in Urban Window
- Perennial water
- Usually water body shown on topo map
- Water in playa mapped as part of the playa (6116)
- Examples include:
  - Park ponds
  - Residential development with recreational lake
  - Reservoirs
  - Curvilinear shaped duck ponds with water
  - Bermed agricultural ponds with water

9801 = Perennial Stream Channel
This type is restricted to a few locations such as near Mojave River Narrows, Afton Canyon, etc. Water is expected to flow throughout most average years. These polygons are coded as 9800 in the Land Use layer and have a MMU=1 acre.

9803 = Small Ponds & Natural Lakes
This type is coded as 9800 in the Land Use layer. These polygons have a MMU=1 acre.

- Small dammed ponds on creeks contain ephemeral water from natural seasonal flow
- May have naturally ponded water in the Mojave River and Colorado River floodplain
- Bermed ponds in agricultural fields are not included

9804 = Aqueduct (California and Colorado River Aqueducts only)
Aqueducts are coded separately because of their unique attributes as a cement-lined or covered water conveyance system. Only open water aqueducts are mapped as a water type in vegetation (code 9804). The aqueduct is also coded in the Land Use layer attribute as 1436 (Water Transfer). The MMU=1 acre for this type.

9805 = Water Impoundment Feature:
These are typically utility or other straight-edged water bodies impounded by berms and may or may not contain water at time of imagery exposure. The MMU is 2.5 acres. Examples are

settling ponds, sewage treatment ponds, salt evaporators, non-curvilinear duck ponds (with and without water), curvilinear duck ponds (without water) and bermed agricultural ponds (no water). The Land Use code for this type is 9810 (Water Impoundment Feature).

Water impoundment features are coded with Development Disturbance of 3 and Anthropogenically Altered Disturbance of 3.

The following criteria are provided to give additional clarification for specific situations regarding water impoundment features:

Flood Control Basins – are not mapped as a 9805 unless they are >10 acres in size. Flood control basins <10 acres in size are mapped as part of a 9300 or 9310 polygon.

Duck Ponds – In situations where there is a mix of duck ponds (curvilinear, non-curvilinear, with and/or without water) that are determined to be in current use, these are, as a whole, mapped as 9805 - not separated into individual 9800 and 9805 polygons.

Inactive duck pond areas with shrubs growing in them are mapped as natural vegetation. Water impoundment features are coded with a Development Disturbance of 3 and Anthropogenic Disturbance of 3.

LAND USE CODES (Land Use layer ONLY):

This code is primarily used for polygons coded in the Vegetation layer as some type of Agriculture, water type, Urban or Urban Window. It is also used for polygons that contain mappable Land Use with >10% natural vegetation. These polygons are coded as vegetation types in the Vegetation layer.

If a polygon is coded in the Vegetation layer as an active agriculture type (code 9210 or 9220), then there is a Land Use code assigned in the Land Use layer (either 2100 or 2200). To determine if a polygon is coded as active agriculture, see the description under vegetation code “9200 = Agriculture” above.

0000 = Not Assigned/Not assessed

1000 = Urban - Areas of built-up land characterized by intensive land use, where most of the land is covered by man-made structures because of human activity. See discussion under vegetation code 9300 and 9310.

1436 = Water Transfer (California and Colorado River Aqueducts only) - see discussion under vegetation code 9804 above.

2100 = Non-woody row & field crops – see discussion under vegetation code 9200 and 9220.

2200 = Orchards & Vineyards – see discussion under vegetation code 9200 and 9210.

9800 = Undifferentiated water – see discussion under vegetation code 9800, 9801, 9803, and 9804.

9810 = Water Impoundment Feature – see discussion under vegetation code 9805.

Appendix E

Reconnaissance Field Form

RECON FIELD FORM (May 17, 2011)

Date:	**Surveyors (circle recorder):**
Waypoint ID:	**GPSname: Projected? Yes / No / Base** If yes, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____(meters)**
UID:	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:	**GPSname: Projected? Yes / No / Base** If yes, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____(meters)**
UID:	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:	**GPSname: Projected? Yes / No / Base** If yes, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____(meters)**
UID:	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

Field Verification Form: DRECP Vegetation Mapping (5/2/2012)

Surveyors (circle recorder)**:**		**Date:**
Waypoint ID: **Polygon UID:**	**GPSname: Projected? Yes / No / Base / Digitized** If projected or digitized, enter base Waypoint ID: **Bearing: _____(degrees) Distance: _____ (meters)** Base UTMs / projected UTMs (circle one) 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

APPENDIX D

DRECP BASELINE BIOLOGY REPORT

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4 NATURAL COMMUNITIES AND BIOLOGICAL SETTING

This section describes the natural communities and floral and faunal diversity associated with these communities in the Plan Area. The mapping of the natural communities, the vegetation types within each community according to the DRECP land cover map is summarized, and the species supported by these communities are described.

4.1 Data Sources

The natural communities and biological diversity description was developed based on the best available existing data and information, including the use of aerial imagery, GIS data sources, resource agency documents, and scientific literature.

4.1.1 Natural Communities

The DRECP land cover map is a detailed map of vegetation types and their associated aggregate natural communities within the Plan Area (see Section 4.2 and Figure 4-1).

The land cover map represents a composite of land cover data that covers the entire Plan Area. The map is generally mapped at a medium-scale resolution suitable for regional and landscape-scale conservation planning, with the exception of a portion of the west Mojave Desert that is mapped at a finer scale. Medium-scale resolution mapping is based on physiognomic, biogeographic, and floristic characteristics. The land cover map uses the current National Vegetation Classification Standard (NVCS) land cover mapping classification and hierarchy, which is consistent with or easily cross-walked from finer-scale land cover datasets and the ongoing land cover mapping in the Plan Area.

While it is desirable to have current and high-resolution land cover data for conservation planning, regional and landscape-scale analyses can be conducted with the type of mid-scale resolution land cover data comprising the DRECP land cover map, which is developed from the best available data covering the Plan Area. Although a comprehensive alliance-level vegetation type data layer is not available at this time, recent vegetation mapping in the West Mojave region mapped at a finer scale (CDFG 2012a) has been incorporated into the Plan Area's land cover map.

The land cover map was developed by combining California Gap (2008 CA-GAP) Vegetation (USGS GAP Program, Lennartz et al. 2008) with updates for agricultural and urban areas. These data include the California Farmland Mapping and Monitoring Program (FMMP) (California Department of Conservation 2009) and a current detailed roads dataset (ESRI 2010) that capture newer land cover changes associated with agricultural and rural development. The specific methods for incorporating updates related to disturbed and

agricultural lands and for integrating the new mapping of the West Mojave are described further below.

As described, the DRECP land cover map was initially based on the 2008 CA-GAP dataset. The base imagery used in the 2008 CA-GAP for image classification and assignment of land cover types was 2001 LANDSAT, which predates agricultural expansion, development, or other significant disturbance occurring since 2001. The current map has been updated with other available land cover and land use data to improve the disturbed, agricultural, and developed land cover types. The update is primarily from the California FMMP data (California Department of Conservation 2009), which includes mapping of all farmland, grazing land, urban and built-up land, large water bodies, disturbed land, and "other" in portions of the Plan Area. FMMP data was used to augment the DRECP land cover map by refining the mapping of the land cover types of agriculture and disturbed.

The FMMP data do not consistently identify or capture rural land use, resulting in differences in mapping classifications in some of these categories among different counties. For example, land cover classified in San Bernardino County generally as "Grazing" includes many similar types of areas that are generally classified as "Other" in Los Angeles County. Both the Grazing type and Other type include substantial areas of rural land use. Due to the inconsistencies in Grazing and Other land classifications in the FMMP data, and the lack of a rural category, a simple model was used to develop a rural category for the land cover map.

Rural land uses generally occur on private lands and have road access. To identify areas with rural land uses, the roads data (ESRI 2010), which is a linear data format at 1:15,000 scale, were used to create polygons, where larger polygons bounded by roads were considered less rural and smaller polygons were considered more rural. The road polygons were then classified into even size classes (e.g., 0 to 100 acres, 101 to 200 acres), and displayed as a GIS overlay on the current aerial imagery of the Plan Area. Review and inspection of the pattern, as well as correspondence of polygon size to evidence of rural land use on aerial images, indicated that most rural land uses occur where the road-bounded polygons were 500 acres or smaller in size. Therefore, road-bounded polygons of 500 acres or smaller that occur on private land were classified as rural. These modeled rural lands were incorporated into the DRECP land cover data layer to replace any underlying natural land cover, but were not incorporated if the underlying land cover was already mapped as farmland, urban, or disturbed from the FMMP data source.

It is important to have a uniform vegetation classification system throughout the Plan Area that reflects the best available information and allows for incorporation of future mapping. The 2008 CA-GAP dataset, which is the primary basis of the land cover map, uses NatureServe's terrestrial ecological systems to classify vegetation communities.

Terrestrial ecological system units are a representation of "practical, systematically defined groupings of plant associations that provide the basis for mapping terrestrial communities and ecosystems at multiple scales of spatial and thematic resolution" (NatureServe 2010). Although the ecological systems use NVCS alliances or associations to describe the vegetation component, the ecological system classification scheme is not fully integrated into the NVCS hierarchical system since the NVCS hierarchical system uses finer-scale or coarser-scale units than the terrestrial ecological system units (NatureServe 2010). Therefore, the classification scheme of the DRECP land cover map has been adapted to the NVCS.

Based on a best-fit strategy (i.e., looking for similarity of species or assemblages), the DRECP land cover map ecological systems were crosswalked to the NVCS "group" level where possible and otherwise to the broader "macrogroup" level. The group level includes combinations of relatively narrow sets of diagnostic plant species, including dominants and co-dominants, broadly similar composition, and diagnostic growth forms. The macrogroup level includes combinations of moderate sets of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences.

With direction from the California Department of Fish and Game (CDFG) Vegetation Classification and Mapping the initial land cover map, vegetation classes were "crosswalked" to the macrogroup and group level in the NVCS. In addition, NatureServe (2010) and Sawyer et al. (2009) vegetation descriptions were used to determine similar community components across vegetation classification systems. The most recent list of NVCS natural communities was used to determine the appropriate macrogroup (CDFG 2010a). In some cases, only the broader macrogroup level was used where the vegetation classes were too inclusive to assign to a more specific group.

In many cases, there was a straightforward crosswalk between classes, with a one-to-one relationship of an NVCS group closely matching the 2008 CA-GAP ecological system. For example, the most common 2008 CA-GAP community in the Plan Area by acreage is Sonora-Mojave creosotebush-white bursage desert scrub (over 8 million acres in the Plan Area). This community maps one-to-one with NVCS lower bajada and fan Mojave–Sonoran desert scrub at the group level. In some cases, the DRECP initial land cover map data representing two or more classes were crosswalked to a single NVCS group. For example, 2008 CA-GAP Apacherian-Chihuahuan mesquite upland scrub and North American warm desert riparian mesquite bosque both map to the NVCS Sonoran-Coloradoan semi-desert wash woodland/scrub group. Where crosswalking to the group level was not possible, communities were crosswalked to the broader NVCS macrogroup level. For example, 2008 CA-GAP Central and Southern California mixed evergreen woodland is best crosswalked to the California forest and woodland macrogroup. Other cleanup of the 2008 CA-GAP data

was conducted to re-class vegetation types from the original data not considered to occur in the Plan Area.

Once the land cover map was adapted to the NVCS system, new vegetation mapping conducted in the West Mojave using the NVCS was incorporated into the land cover map using the common classification system. Although the new West Mojave mapping data is mapped at the alliance level, this finer-scale data was aggregated to the group level within the common NVCS system to maintain a common hierarchical level across the Plan Area for conservation planning purposes. The current DRECP land cover map includes the first segment of the new mapping data for the West Mojave (approximately 1.1 million acres of the Plan Area).

4.1.2 Species

Section 4.3.1 describes the plant and animal species associated with each natural community in the Plan Area. The floral and faunal species richness and diversity discussions in Sections 4.3.2 and 4.3.3 provide an overview of the biological diversity in the Plan Area. The description in this section is not intended to focus on the specific natural history or data related to specific species or groups of species. Information and data related to specific species is provided in Section 5.

4.2 Natural Communities and Land Covers

"Natural communities" are defined as assemblages of vegetation types and the plant and animal species that use those vegetation types as habitat. A natural community is generally characterized by the similarities in the vegetation types and the natural ecological processes that dominate the community and give it its unique characteristics. For example, a shrubland natural community is made of a number of shrub, scrub, and chaparral vegetation types, the associated plant and animal species, the distribution of which is shaped by the patterns of microclimate as determined by precipitation, slope and aspect, and by fire regime. Vegetation types are defined by a vegetation classification scheme based on the plant species growing together with characteristically uniform structures and habitats, consistent species compositions, and recurrence across the landscape (Jennings et al. 2009). The DRECP land cover map uses the NVCS hierarchical classification system, generally at the macrogroup or group level (see Section 4.1.1). Vegetation types are also commonly referred to as vegetation series or plant communities (Sawyer et al. 2009). Vegetation types are typically characterized by reference to one or more dominant species (Lincoln et al. 1998).

The Plan Area has been crosswalked or mapped using the NVCS classification system, as described in Section 4.1.1. This system has been developed to enable the production of

uniform information regarding vegetation resources across the nation, based on vegetation data gathered at varying geographical scales (FGDC 2008). The NVCS uses a hierarchical system of mapping that includes:

- Upper levels that are predominantly physiognomic, based on physical landscape features and vegetation structure:

  1. Formation class;
  2. Formation subclass; and
  3. Formation.

- Middle levels that are physiognomic, biogeographic, and floristic (i.e., based on species identity):

  4. Division;
  5. Macrogroup; and
  6. Group.

- Lower levels that are predominantly floristic:

  7. Alliance; and
  8. Association.

Although portions of the Mojave Desert have been mapped recently at the more specific alliance level, the majority of the Plan Area is generally mapped at the macrogroup or group level, as described in Section 4.1.1. The macrogroup is defined as "combinations of moderate sets of diagnostic plant species and diagnostic growth forms that reflect biogeographic differences in composition and subcontinental to regional differences in mesoclimate, geology, substrates, hydrology, and disturbance regimes" (Sawyer et al. 2009). The more specific group level is defined as "combinations of relatively narrow sets of diagnostic plant species (including dominants and co-dominates), broadly similar composition, and diagnostic growth forms that reflect regional mesoclimate, geology, substrates, hydrology, and disturbance regimes" (Sawyer et al. 2009). Table 4-1 provides a summary of the natural communities under California NVCS in the Plan Area at the general natural community, macrogroup, and group levels. This section describes the composition and location of the macrogroups and groups within each general natural community. More detailed descriptions of these macrogroups and groups in the Plan Area are currently being developed.

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

NATURAL COMMUNITY Macrogroup Group	Acres
DUNE COMMUNITY	**439,354**
North American Warm Semi-Desert Cliff, Scree, and Other Rock Vegetation	—
North American warm desert dunes and sand flats	439,354
FOREST COMMUNITY	**82,984**
Californian-Vancouverian Montane and Foothill Forest	—
Californian montane conifer forest	82,984
GRASSLAND COMMUNITY	**186,382**
California Annual and Perennial Grassland	163,326
California annual forb/grass vegetation	6,805
Mediterranean California naturalized annual and perennial grassland	16,166
Inter-Mountain Dry Shrubland and Grassland	—
Southern Great Basin semi-desert grassland	75
Western North American Temperate Grassland and Meadow	10
RIPARIAN COMMUNITY	**75,262**
Southwestern North American Riparian, Flooded and Swamp Forest	64,229
Southwestern North American introduced riparian scrub	7,976
Southwestern North American riparian evergreen and deciduous woodland	2,411
Southwestern North American riparian/wash scrub	646
ROCKY, BARREN, AND UNVEGETATED COMMUNITY	**6,823,992**
California Cliff, Scree, and Other Rock Vegetation	2
North American Warm Semi-Desert Cliff, Scree, and Other Rock Vegetation	—
Desert Playa	555,673
North American warm desert bedrock cliff and outcrop	6,268,035
Vancouverian Cliff, Scree and Other Rock Vegetation	—
Sierra Nevada cliff and canyon	282
SCRUB AND CHAPARRAL COMMUNITY	**12,543,494**
California Chaparral	—
Californian mesic chaparral	2,411
Californian xeric chaparral	45,079
Californian pre-montane chaparral	1,266
California Coastal Scrub	—
Central and south coastal California coastal sage scrub	26,078
Central and south coastal California seral scrub	539

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

NATURAL COMMUNITY Macrogroup Group	Acres
Cool Semi-Desert Alkali-Saline Flats	—
Shadscale-saltbush cool semi-desert scrub	694,018
Cool Semi-Desert Wash and Disturbance Scrub	—
Intermontane seral shrubland	50,303
Inter-Mountain Dry Shrubland and Grassland	1,912,378
Intermontane deep or well-drained soil scrub	47,285
Mojave and Great Basin upper bajada and toeslope	42,867
Madrean Warm Semi-Desert Wash Woodland/Scrub	985,566
Mojavean semi-desert wash scrub	9,058
Sonoran-Coloradan semi-desert wash woodland/scrub	10,548
Mojavean-Sonoran Desert Scrub	—
Arizonan upland Sonoran desert scrub	23,694
Lower bajada and fan Mojavean-Sonoran desert scrub	8,604,891
Warm Interior Chaparral	—
Western Mojave and western Sonoran Desert borderland chaparral	2,604
Western North America Tall Sage Shrubland and Steppe	—
Inter-mountain west mesic tall sagebrush shrubland and steppe	84,909
WETLAND COMMUNITY	**312,217**
Cool Semi-Desert Alkali-Saline Wetlands	—
Great Basin cool semi-desert alkali basin	872
Warm Semi-Desert/Mediterranean Alkali-Saline Wetland	—
Southwestern North American salt basin and high marsh	84,947
Western North America Wet Meadow and Low Shrub Carr	—
Californian warm temperate marsh/seep	8
Western North American Freshwater Marsh	268
Arid west freshwater emergent marsh	5,259
Open Water	220,863
WOODLAND COMMUNITY	**180,505**
California Forest and Woodland	29
Californian broadleaf forest and woodland	86,903
Intermountain Basins Pinyon-Juniper Woodland	—
Western Great Basin montane conifer woodland	93,280
Rocky Mountain Subalpine and High Montane Conifer Forest	—
Rocky Mountain mesic subalpine forest and woodland	293

Table 4-1
Summary of Natural Communities and Other Land Cover in Plan Area

NATURAL COMMUNITY Macrogroup Group	Acres
OTHER LAND COVERS	**1,942,702**
Agriculture	**758,021**
Developed and Disturbed Areas	**1,170,824**
Developed	394,271
Disturbed Lands	15,474
Rural	761,079
Not Mapped	**13,857**
Total	**22,586,892**

4.2.1 Dune Community

The dune community comprises approximately 1.9% (439,354 acres) of the Plan Area and includes one macrogroup: North American warm semi-desert cliff, scree, and other rock vegetation. North American warm desert dunes and sand flats is the only group in the macrogroup. The dune community occurs throughout the Plan Area, with approximately 16 named dune systems, including approximately 12 systems in the Mojave Desert and lower Great Basin Desert and 4 systems in the Sonoran Desert, as well as numerous smaller dunes that are included in the mapping. The largest dune area, which includes the Algodones Dunes, is located in the East Mesa-Sand Hill portion of the Sonoran Desert.

4.2.2 Forest Community

The forest community in the Plan Area comprises approximately 0.4% (82,984 acres) of the land cover and is limited to the higher elevations in the Plan Area, where it occurs primarily in the Piute Mountains in Kern County and the mountains in southwest San Bernardino County (Figure 4-1). One macrogroup occurs in the Plan Area: Californian-Vancouverian montane and foothill forest, all of which is in the California montane conifer forest group.

4.2.3 Grassland Community

The grassland community covers less than 1% (186,382 acres) of the Plan Area and includes three macrogoups: California annual and perennial grassland, inter-mountain dry shrubland and grassland, and western North American temperate grassland and meadow (Figure 4-1; Table 4-1).

The California annual and perennial grassland macrogroup is the most common grassland in the Plan Area, accounting for 88% (163,326 acres) of the grassland community, and includes two groups: California annual forb/grass vegetation and Mediterranean California naturalized annual and perennial grassland. This macrogroup is most common in the western portion of the Plan Area, especially along the boundary from east of Bakersfield to the southern end of the San Bernardino National Forest. The inter-mountain dry shrubland and grassland macrogroup contains only the southern Great Basin semi-desert grassland group and accounts for a very small area (75 acres) in the northwestern portion of the Plan Area. The western North American temperate grassland and meadow macrogroup is only mapped at the macrogroup level and accounts for only 10 acres in the Plan Area along Ana Verde Creek in the Mojave Desert.

4.2.4 Riparian Community

The riparian community comprises approximately 0.3% (75,262 acres) of the Plan Area and includes only one macrogroup: southwestern North American riparian, flooded and swamp forest (Figure 4-1; Table 4-1). About 85% of the riparian community is mapped only at the macrogroup level. The groups in the Plan Area that account for the remaining 15% of the riparian community are southwestern North American introduced riparian scrub, southwestern North American riparian evergreen and deciduous woodland, and southwestern North American riparian/wash scrub. The southwestern North American riparian, flooded and swamp forest macrogroup occurs throughout the Plan Area, but is more common in the Colorado Desert, Owens Valley, Tehachapi-Piute Mountains, and along the Colorado River.

4.2.5 Rocky, Barren, and Unvegetated Community

The rocky, barren, and unvegetated community is the second-most common community in the Plan Area behind scrub and chaparral and covers approximately 30% (6,823,992 acres) of the total area. This community includes three macrogroups: California cliff, scree, and other rock vegetation; North American warm semi-desert cliff, scree, and other rock vegetation; and Vancouverian cliff, scree, and other rock vegetation (Figure 4-1; Table 4-1).

The California cliff, scree, and other rock vegetation macrogroup covers only 2 acres in the Plan Area. The North American warm semi-desert cliff, scree, and other rock vegetation macrogroup includes the desert playa group and the North American warm desert bedrock cliff and outcrop group, the latter of which accounts for 92% (6,268,035 acres) of the rocky, barren, and unvegetated community in the Plan Area. The North American warm desert bedrock cliff and outcrop group occurs throughout the Plan Area in association with the many mountain ranges. The desert playa group, which comprises more than 555,000 acres,

occurs in a scattered distribution in the Mojave Desert and southern Owens Valley, with relatively large contiguous areas in the Death Valley area, Owens Lake, Searles Valley, Panamint Valley, Edwards Air Force Base, Devil's Playground, Bristol Dry Lake, Cadiz Valley, Ward Valley, and Soda Lake in the western portion of the Mojave National Preserve (Figure 4-1). The Vancouverian cliff, scree, and other rock vegetation macrogroup includes only the Sierra Nevada cliff and canyon group, which is limited to the western edge of the Plan Area in the Sierra Nevada.

4.2.6 Scrub and Chaparral Community

The scrub and chaparral community makes up the majority of the Plan Area (approximately 55% or 12,543,494 acres) (Figure 4-1). There are seven scrub macrogroups and two chaparral macrogroups in the Plan Area (Table 4-1).

The Mojavean-Sonoran desert scrub macrogroup, which comprises the majority of the scrub communities in the Plan Area, consists of two groups: the lower bajada and fan Mojavean-Sonoran desert scrub group is much more common than Arizonan upland Sonoran desert scrub group. The lower bajada and fan Mojavean-Sonoran desert scrub group, at more than 8.6 million acres, is by far the single most common vegetation type in the Plan Area, comprising 38% of the total area.

The California coastal scrub macrogroup includes two groups: central and south coastal California coastal sage scrub and central and south coastal California seral scrub. This macrogroup occurs primarily in the northwestern portion of the Plan Area along the northern edge of the High Desert Plains and Hills ecoregion subsection of the Mojave Desert. The cool semi-desert alkali-saline flats macrogroup is all mapped in the shadscale–saltbush cool semi-desert scrub group. This occurs throughout the Plan Area, with larger areas in the Mojave Desert and Owens Valley. The cool semi-desert wash and disturbance scrub macrogroup includes the intermontane seral shrubland group, which is primarily in the western portion of the Mojave Desert in the Plan Area.

The inter-mountain dry shrubland and grassland macrogroup includes two groups, but is primarily mapped only at the macrogroup level. The intermontane deep or well-drained soil scrub and Mojave and Great Basin upper bajada and toeslope groups together comprise less than 5% of the macrogroup acreage. The macrogroup occurs primarily in the northern portion of the Plan Area, especially in the eastern slopes of the Sierra Nevada, the western portion of the Owens Valley, the Kingston Range-Valley Wells, and the Providence Mountains-Lanfair Valley. The Madrean warm semi-desert wash woodland/scrub macrogroup is mapped primarily at the macrogroup level, but also includes two groups: Mojavean semi-desert wash scrub and Sonoran–Coloradan semi-desert wash

woodland/scrub. This macrogroup is most common in the southeastern portion of the Plan Area. This macrogroup is generally common throughout the Plan Area except in the Coachella and Imperial valleys and the westernmost portion of the Plan Area. The western North America tall sage shrubland and steppe macrogroup contains one group: the inter-mountain west mesic tall sagebrush shrubland and steppe. This group is primarily located in the Sierra Nevada and the northern portion of the Providence Mountains-Lanfair Valley ecoregion subsection of the Mojave Desert.

The California chaparral macrogroup includes three groups: Californian mesic chaparral, Californian xeric chaparral, and Californian pre-montane chaparral, with Californian xeric chaparral being the most common chaparral group in the Plan Area. The California chaparral macrogroup occurs primarily along the western boundary of the Plan Area. The warm interior chaparral macrogroup, which is also located along the western boundary of the Plan Area, contains only the western Mojave and western Sonoran Desert borderland chaparral group.

4.2.7 Wetland Community

The wetland community covers approximately 1.4% (312,217 acres) of the Plan Area and includes five macrogroups: cool semi-desert alkali-saline wetlands, warm semi-desert/Mediterranean alkali-saline wetland, western North American wet meadow and low shrub carr, western North American freshwater marsh, and open water (Figure 4-1). Each of these macrogroups contains only one group in the Plan Area (Table 4-1). The Great Basin cool semi-desert alkali basin and Southwestern North American salt basin and high marsh groups are alkali-saline wetlands that occur in the central and northern portions of the Plan Area, primarily in the Mojave Valley-Granite Mountains and Owens Valley. The Californian warm temperate marsh/seep group comprises only 8 acres near Lancaster.

The western North American freshwater marsh macrogroup is primarily composed of the arid west freshwater emergent marsh group, but approximately 268 acres are mapped only at the macrogroup level. This macrogroup occurs primarily in the Owens Valley, along the northeastern boundary of the Plan Area, in the High Desert Plains and Hills ecoregion subsection of the Mojave Desert, and in and north of Moabi Regional Park along the eastern boundary of the Plan Area.

The open water macrogroup accounts for approximately 71% (220,863 acres) of the wetland community in the Plan Area, of which, 192,000 acres (87%) is the Salton Sea.

4.2.8 Woodland Community

The woodland community comprises 0.8% (180,505 acres) of the Plan Area. There are three macrogroups in the Plan Area, each with one group (Table 4-1).

The California forest and woodland macrogroup occurs in the Sierra Nevada in the northwestern portion of the Plan Area, east of Bakersfield (Figure 4-1). There are 29 acres mapped only at the broader macrogroup level, but the majority of this macrogroup falls within the California broadleaf forest and woodland group.

The intermountain basins pinyon–juniper woodland macrogroup generally occurs in the Sierra Nevada, the Little San Bernardino, Bighorn, and San Gorgonio mountains, all of which is within the western Great Basin montane conifer woodland group. There are also patches in the mountain ranges of the Eastern Mojave as well; these occur in the Kingston Range, Clark Mountain Range, Nopah Range, Funeral Mountains, New York Mountains, Providence Mountains, and Granite Mountains.

The Rocky Mountain subalpine and high montane conifer forest macrogroup occurs in the Sierra Nevada in the northwestern portion of the Plan Area. All of this macrogroup in the Plan Area is within the Rocky Mountain mesic subalpine forest and woodland group.

4.2.9 Other Land Covers

4.2.9.1 Agriculture

Agricultural areas are mapped over approximately 3.4% (758,021 acres) of the Plan Area and are concentrated in three main regions: the Imperial Valley south of the Salton Sea, the Palo Verde Valley in the Blythe region, and the Antelope Valley in the western Mojave Desert (Figure 4-1; Table 4-1).

Almost 500,000 acres in Imperial County are in agricultural production (Imperial County Farm Bureau 2011). Field crops account for most of the land in production, including about 166,000 acres of alfalfa; 66,000 acres of Sudangrass for hay; 44,000 acres of wheat; and 34,000 acres of sugar beets (UC Davis 2011a). Major vegetable crops include lettuce, cabbage, carrots, onions, broccoli, cauliflower, sweet corn, bell pepper, chili peppers, cantaloupes, mixed melons, and watermelons (UC Davis 2011a). Imperial County also supports the largest number of feedlot and fed cattle in California (UC Davis 2011a).

The Palo Verde Valley supports about 108,000 acres of agricultural lands, of which about 60% is alfalfa, 11% cotton, 6% wheat and barley, and 5% Sudangrass and Bermuda grass (Barrows 2007). Agriculture in the Antelope Valley is on a much smaller scale than the

Imperial and Palo Verde valleys. The acreage of vegetable crops in the Antelope Valley increased from about 9,090 acres in 1999 to 11,670 acres in 2000, due primarily to the carrot industry (UC Davis 2011a). Other crops include alfalfa, dry onions, carrots, potatoes, peaches, grapes, and nectarines.

4.2.9.2 Developed and Disturbed Areas

Developed land is mapped over approximately 1.7% (394,271 acres) of the Plan Area and includes low- to high-intensity urban development and open space associated with developed areas, including uses such as golf courses. Developed areas are concentrated in the western Mojave in the Palmdale/Lancaster area; Victorville, Barstow, and Ridgecrest; and in the Sonoran Desert in the El Centro area of the Imperial Valley and Blythe area (Figure 4-1). Lands mapped as disturbed lands cover approximately 0.07% (15,474 acres) of the Plan Area and generally are limited to the western Mojave area west and north of Edwards Air Force Base and the Ridgecrest area. Lands mapped as rural cover approximately 3.4% (761,079 acres) of the Plan Area and include areas of rural development in the western Mojave, Morongo Valley, western Imperial Valley, and Blythe areas.

A small portion of the Plan Area, located largely in the west Mojave, Imperial Valley, and along the eastern edge of the Plan Area, is classified as "unmapped" due to lack of data in the source data for the land cover layer. These areas are primarily characterized by rural development or agricultural land uses.

4.3 Biological Diversity

The tremendous biological diversity of the Plan Area reflects the size and geographic diversity of the Plan Area. The Plan Area includes parts of three floristic provinces in California: (1) the Desert Province consists of the Mojave and Sonoran deserts; (2) the Great Basin Province east of the Sierra Nevada; and (3) the California Floristic Province (Baldwin et al. 2002). Although these boundaries are distinct geographic divisions, the plant communities and species often exhibit gradual transitions between the provinces (Baldwin et al. 2002). It is often at these transition zones where biological diversity and species richness is particularly high because of mixed transitional plant communities and shared species. As described previously, the Plan Area also has numerous mountain ranges, valleys, and basins and elevation ranges from less than 200 feet below MSL to more than 7,900 feet above MSL. This topographic diversity, which influences precipitation, runoff, and temperature patterns, supports a large range of environmental gradients that are associated with different plant and animal species assemblages.

4.3.1 Natural Communities and Land Covers

This section discusses plant and wildlife species that are closely associated with the natural communities identified in Section 4.2.

4.3.1.1 Dune Community

The dune community comprises approximately 1.9% of the Plan Area. As discussed in Section 2.1.3, the Plan Area supports approximately 16 major dune systems in the Plan Area, including about 12 in the Mojave Desert and Southern Great Basin Desert and about 4 in the Sonoran Desert (Pavlik 1985). As isolated systems with unique habitat conditions (i.e., actively shifting sand), many species occurring in sand dunes are specifically adapted and restricted to dune habitats. In a study of Mojave and Great Basin desert dunes systems, Pavlik (1985, pp. 205–206) made the following observations about dune flora:

> *1) The taxonomic composition of the dune flora differs from that the desert as a whole; 2) dune vegetation has a distinctive life form spectrum that may be related to sand movement; 3) a subset of the flora appears to be edaphically restricted to dunes and patches of sand habitat; and 4) the presence of endemic taxa at several dunes indicates some degree of geographic and ecologic isolation through time.*

Pavlik (1985) found that common dune flora included members of Asteraceae, Fabaceae, Chenopodiaceae, and Polemoniaceae and was somewhat deficient in Poaceae. Pavlik also found that approximately 95% of the dune taxa were indigenous. About 68% of sand dune flora recorded by Pavlik (1985) consisted of annuals (50%) and geophytes (18%). The relative abundance of annuals and geophytes compared to perennial shrubs appears to be a response to shifting sand conditions. Pavlik (1985) notes that annual species have higher rates of carbon assimilation, growth, and development that minimizes the exposure time to the harsh dune conditions (i.e., burial, abrasion, and deflation). Geophytes have ephemeral shoots and rhizomes or rootstocks that can support buds near dune surface (Pavlik 1985). Common herbaceous dune plant species include sand verbena (*Abronia villosa*), showy desert-marigold (*Baileya pauciradiata*), desert lily (*Hesperocallis undulata*), basket evening primrose (*Oenothera deltoides* ssp. *deltoides*), and fanleaf crinklemat (*Tiquilia plicata*) (Baldwin et al. 2002).

Similar to plant species, dune wildlife species often are uniquely adapted to the dunes. Fringe-toed lizards (*Uma* spp.) have morphological adaptations to living on fine sands, including velvety skin, fringed toes with projecting point scales, a countersunk lower jaw, earflaps, and camouflage (Stebbins 1985). The three species in the Mojave and Sonoran deserts are endemic to different dune systems: the Colorado fringe-toed lizard (*Uma*

notata) occurs in the Algodones Dunes in the Sonoran Desert; the Mojave fringe-toed lizard (*Uma scoparia*) occurs in dunes systems in the Mojave Desert north to the southern end of Death Valley and south to about Parker, Arizona; and the Coachella Valley fringe-toed lizard (*Uma inornata*) occurs in the Coachella Valley west of the Plan Area within the Coachella Valley Multiple Species Habitat Conservation Plan (Stebbins 1985).

Dune systems also support several endemic invertebrate species. As stated in an ISA (2010, p. 15) report:

> The Kelso Dunes alone have 10 described endemic arthropods (eight beetles, a sand-treader cricket, and a Jerusalem cricket); the Algodones Dunes have eight (seven beetles, one sand-treader cricket); and every southern California dune system that has received any level of taxonomic surveys has one or more endemic arthropods (at least 30 or 40 overall).

The CDFG Wildlife Species Matrix (CDFG 2011) includes several invertebrate species documented in the different dune systems, including Kelso Dune glaresis scarab beetle (*Glaresis arenata*), Kelso Jerusalem cricket (*Ammopelmatus kelsoensis*), Kelso giant sand treader cricket (*Macrobaenetes kelsoensis*), Saline Valley snow-front June beetle (*Polyphylla anteronivea*), and brown-tassel trigonoscuta weevil (*Trigonoscuta brunnotesselata*) in the Mojave Desert. Invertebrates in the Sonoran Desert dune systems include Carlson's dune beetle (*Anomala carlsoni*), Hardys' dune beetle (*Anomala hardyorum*), and Andrews' dune scarab beetle (*Pseudocotalpa andrewsi*) (CDFG 2010b).

At least one small mammal—desert kangaroo rat (*Dipodomys deserti*)—is closely associated with dune habitats throughout the Mojave and Sonoran deserts where it digs burrows at the base of perennial shrubs in more stabilized areas of dunes and not in areas of rapidly shifting sand (Hoffmeister 1986).

4.3.1.2 Forest Community

The forest community in the Plan Area comprises approximately 0.4% of the land cover and is limited to the higher elevations in the Plan Area, where they occur primarily in the Piute Mountains in Kern County and the mountains in southwest San Bernardino County (Figure 4-1). Similar to oak woodlands and forests, conifer forests provide important breeding and foraging habitat for many species that do not occur in lower elevation habitats, such as Cassin's finch (*Carpodacus cassinii*) and Clark's nutcracker (*Nucifraga columbiana*). The relatively high proportion of decadent trees typically found in high elevation conifer forest provide cavity and snag nesting habitat. Conifers also provide a large insect prey base for many bird species, including a variety of warblers. Jeffrey pine (*Pinus jeffreyi*) provides seed for many species, as well as bark and foliage that are food

sources for squirrels (Sciuridae) and mule deer (*Odocoileus hemionus*). Coniferous forest is also important transitory habitat for mule deer during migration. Due to the relatively small amount of conifer forest in the Plan Area and its limitation to the western boundaries, the wildlife populations dependent on coniferous habitats probably are relatively small, but include several bird species that are common in coniferous habitats, such as Steller's jay (*Cyanocitta stelleri*), Clark's nutcracker, pinyon jay (*Gymnorhinus cyanocephalus*), and mountain chickadee (*Poecile gambeli*). Small mammals such as chipmunks are also strongly associated with coniferous habitats. Several other small mammals that occur in the coniferous habitats also are common in the woodland and savannah and scrub and chaparral habitats, including deermouse (*Peromyscus* spp.) and woodrats (*Neotoma* spp.). Common reptiles occurring in coniferous habitats include California kingsnake (*Lampropeltis getula californiae*), California mountain kingsnake (*Lampropeltis zonata*), western rattlesnake (*Crotalus oreganus*), gophersnake (*Pituophis cantifer*), common gartersnake (*Thamnophis sirtalis*), western fence lizard (*Sceloporus occidentalis*), and side-blotched lizard (*Uta stansburiana*), most of which are also common at lower elevations. Uncommon reptiles and amphibians occurring at higher elevations and associated with coniferous forests include southern rubber boa (*Charina umbratica*) and yellow-legged frogs (*Rana* spp.).

4.3.1.3 Grassland Community

The grassland vegetation community covers approximately 0.8% of the Plan Area (Figure 4-1). Additionally, North American warm desert playas also support some grasslands (e.g., saltgrass [*Distichlis spicata]*) and may support large areas of herbaceous cover at times.

Desert grasslands provide important habitat for a wide variety of bird species. The bird community in desert grasslands can be characterized by three foraging types: raptors, insectivores, and granivores. Birds in these groupings may overlap somewhat (i.e., some of the raptors and the granivores also take insect prey), but the ecological niches supporting these groups are fairly distinct. It should be noted that most of the birds occurring in desert grasslands are fairly widespread in the California deserts and not generally restricted to desert grassland habitats.

Common raptors that forage in the desert grasslands include golden eagle (*Aquila chrysaetos)*, ferruginous hawk (*Buteo regalis)*, northern harrier (*Circus cyaneus)*, Swainson's hawk (*Buteo swainsoni)*, red-tailed hawk (*Buteo jamaicensis)*, prairie falcon (*Falco mexicanus*), American kestrel (*Falco sparverius)*, merlin (*Falco columbarius*), burrowing owl (*Athene cunicularia)*, short-eared owl (*Asio flammeus*), great horned owl (*Bubo virginianus*), and loggerhead shrike (*Lanius ludovicianus)*. The larger species, such as golden eagle, red-tailed hawk, and great horned owl, primarily prey on rodents,

lagomorphs, and reptiles, and the smaller species, such as American kestrel, burrowing owl, short-eared owl, and loggerhead shrike, include smaller rodents, reptiles, amphibians, small birds, and larger insects in their diet. Birds occurring in desert grasslands that are primarily insectivores include lesser nighthawk (*Chordeiles acutipennis)*, common nighthawk ([*Chordeiles minor*] limited mostly to Owens Valley), western kingbird (*Tyrannus verticalis)*, Cassin's kingbird (*Tyrannus vociferans*), Say's phoebe (*Sayornis saya)*, horned lark (*Eremophila alpestris),* and western meadowlark (*Sturnella neglecta)*. Most granivorous birds, such as sparrows and finches, also include insects in their diets during the breeding season. This group is characterized by stout beaks adapted to seed eating, and includes vesper sparrow (*Pooecetes gramineus*), savannah sparrow (*Passerculus sandwichensis*), lark sparrow (*Chondestes grammacus*), black-throated sparrow (*Amphispiza bilineata*), and house finch (*Carpodacus mexicanus*).

Similar to birds, mammals occurring in grasslands can be categorized by their primary foraging habitats: herbivores, granivores, omnivores, and carnivores. Further, most mammal species using desert grasslands require other habitats for important aspects of their daily activities for their life history. For example, many of the mammals found in grasslands use shrubs, rocks, and other substrates for cover, refuge, or nesting and burrowing. For this reason, many of the mammals using desert grasslands occur in grassland/shrubland mosaics and shrub steppe vegetation types more frequently than monotypic grasslands.

Common desert grassland herbivores (grazers and browsers) include desert cottontail (*Sylvilagus audubonii)*, black-tailed jackrabbit (*Lepus californicus)*, white-tailed antelope squirrel (*Ammospermophilus leucurus)*, round-tailed ground squirrel (*Xerospermophilus tereticaudus)*, the endemic Mohave ground squirrel (*Xerospermophilus mohavensis)*, and Botta's pocket gopher (*Thomomys bottae)*. These species primarily forage on grasses and forbs, but may also feed on leaves, flowers, fruits, seeds, and the squirrels also eat insects and spiders. As a subterranean species, the pocket gopher feeds mostly on roots, tubers, and bulbs.

The granivores using desert grasslands include kangaroo rats, pocket mice, and other mice. The two kangaroo rats most likely to occur in grassland habitats are Merriam's kangaroo rat and chisel-toothed kangaroo rat (*Dipodomys microps*) in the Great Basin Desert. However, as a specialist on shadscale (*Atriplex confertifolia*) leaves, the chisel-toothed kangaroo rat also is restricted to areas with a mix of shrubs. Pocket mice are less likely to occur in large, shrubless grassland areas because they primarily forage for seeds under shrubs and, as quadrupeds, are less able to move quickly across large grassland areas compared to the bipedal and highly mobile kangaroo rats.

At least three omnivorous rodents, deermouse, western harvest mouse (*Reithrodontomys megalotis)*, and non-native house mouse (*Mus musculus*), occur in grasslands. The deermouse and western harvest mouse are ubiquitous and the house mouse occurs in association with developed and disturbed areas. These species feed on seeds, fruits, and invertebrates.

Several mammalian carnivores hunt in desert grasslands for lagomorphs, rodents, birds, reptiles, amphibians, and larger invertebrates, including coyote (*Canis latrans)*, kit fox (*Vulpes macrotis*), gray fox (*Urocyon cinereoargenteus)*, and American badger. The carnivorous southern grasshopper mouse (*Onychomys torridus*) also occurs in grasslands, scrub-grassland mosaics, and shrub steppe vegetation types, feeding almost exclusively on arthropods such as scorpions and grasshoppers, crickets, caterpillars, moths, and darkling beetles. Southern grasshopper mouse also occasionally takes small vertebrates and forages for seeds.

Desert grasslands, including grassland/shrubland mosaics and shrub steppe vegetation types, provide habitat for several reptile species, but similar to the mammals, these species occur in other vegetation types that provide cover, prey, and refuge (e.g., rocks, burrows, and debris). Snakes commonly occurring in desert grasslands include night snake (*Hypsiglena torquata)*, California kingsnake, coachwhip (*Coluber flagellum)*, gophersnake, long-nosed snake (*Rhinocheilus lecontei*), western patch-nosed snake (*Salvadora hexalepis)*, western groundsnake (*Sonora semiannulata),* western diamond-backed rattlesnake (*Crotalus atrox*), and northern Mohave rattlesnake (*Crotalus scutulatus scutulatus*). These snakes primarily prey on lizards, small mammals, smaller snakes, nesting birds, and amphibians. Fewer lizards occupy grasslands, but include side-blotched lizard, long-nosed leopard lizard (*Gambelia wislizenii*), western fence lizard, and desert spiny lizard (*Sceloporus magister)*.

4.3.1.4 Riparian Community

The riparian community comprises approximately 0.3% of the Plan Area and can be associated with springs and areas of surface water, which provide some of the most productive wildlife habitat in the Plan Area (Figure 4-1). These "oases" provide water, cover, shade, and abundant food resources (e.g., insects and other invertebrates) for migrating and resident bird species. Some of the important oases in the Plan Area include the Lower Colorado River system; riparian habitats associated with the Salton Sea in Imperial and Riverside counties; Agua Caliente Springs, Borrego Springs, Bow Willow Springs, and Dos Cabezas Spring in eastern San Diego County; Morongo Valley, Twentynine Palms, Box S Spring, Old Woman Spring, and Sarasota Spring in San Bernardino County; and Amargosa River, Furnace Creek Ranch, and Scotty's Castle in Inyo County (Small 1994).

Many bird species nest in desert riparian habitats in the Plan Area, including southwestern willow flycatcher (*Empidonax traillii extimus*), least Bell's vireo (*Vireo bellii pusillus*), hairy woodpecker (*Picoides villosus*), vermilion flycatcher (*Pyrocephalus rubinus*), Lucy's warbler (*Oreothlypis luciae*), yellow warbler (*Dendroica petechia*), elf owl (*Micrathene whitneyi*) (only along the Colorado River), brown-crested flycatcher (*Myiarchus tyrannulus*), black phoebe (*Sayornis nigricans*), great-tailed grackle (*Quiscalus mexicanus*), yellow-breasted chat (*Icteria virens*), common yellowthroat (*Geothlypis trichas*), summer tanager (*Piranga rubra*), blue grosbeak (*Passerina caerulea*), song sparrow (*Melospiza melodia*), and black-billed magpie (*Pica hudsonia*) (only northern Mojave Desert and Owens Valley). Other species are migrants or winter visitors in desert riparian habitats, including red-naped sapsucker (*Sphyrapicus nuchalis*), belted kingfisher (*Ceryle alcyon)*, tree swallow (*Tachycineta bicolor*), house wren (*Troglodytes aedon*), spotted towhee (*Pipilo maculatus*), vesper sparrow, and lark sparrow.

Bird species occurring in both desert riparian and desert wash include Gila woodpecker (*Melanerpes uropygialis*), ash-throated flycatcher (*Myiarchus cinerascens*), crissal thrasher (*Toxostoma crissale)*, orange-crowned warbler (*Oreothlypis celata*), Gambel's quail (*Callipepla gambelii*), common nighthawk, verdin (*Auriparus flaviceps*), green-tailed towhee (*Pipilo chlorurus*), Abert's towhee (*Melozone aberti*), and gilded flicker (*Colaptes chrysoides*).

Many other bird species, as well as reptiles and mammals, that are not desert riparian or desert wash dependent often use these habitats for water and food resources. Reptiles and mammals that commonly occur in sandy soils, such as sidewinder (*Crotalus cerastes)*, desert horned lizard (*Phrynosoma platyrhinos*), desert iguana (*Dipsosaurus dorsalis)*, zebra-tailed lizard (*Callisaurus draconoides*), little pocket mouse (*Perognathus longimembris*), and desert pocket mouse (*Chaetodipus penicillatus*) are often found in desert washes.

Common amphibians found in desert riparian and desert wash habitats include Baja California treefrog (*Pseudacris hypochondriaca)* and Woodhouse's toad (*Anaxyrus woodhousii*), red-spotted toad (*Anaxyrus punctatus*), great plains toad (*Bufo cognatus*), Baja California treefrog (*Pseudacris hypochondriaca*), and Rio Grande leopard frog (*Lithobathes berlandieri*) (introduced in Lower Colorado River and Imperial County area). Less common amphibians associated with desert riparian and wash habitats include arroyo toad (*Anaxyrus californicus*), Sonoran desert toad (*Ollotis alvaria*) (previously called Colorado River toad [*Bufo alvarius*]), Arizona toad (*Anaxyrus microscaphus*), and Couch's spadefoot (*Scaphiopus couchii*). Arroyo toad in the Plan Area is limited to the desert slopes of the Transverse Ranges and currently is only known from the upper Mojave River area. The California range of the Sonoran desert toad is limited to the extreme southeast portion of the Sonoran Desert. This species has not been collected since 1955 and may be extirpated

from California (Jennings and Hayes 1994). Couch's spadefoot is known from scattered locations east of the Algodones Dunes and north into San Bernardino County (CaliforniaHerps 2011).

4.3.1.5 Rocky, Barren, and Unvegetated Community

The rocky, barren, and unvegetated community covers approximately 30% of the Plan Area (Figure 4-1). Although these areas are generally unvegetated, they may include areas of sparse shrub cover that provide wildlife habitat.

Several birds are associated with unvegetated and sparsely vegetated areas. The rock wren (*Salpinctes obsoletus)* uses rock outcrops, talus slopes, cliffs, and banks where it gleans spiders, insects, and other small invertebrates from rocks and crevices and also nests under large rocks or in cavities and crevices among the rocks. The canyon wren (*Catherpes mexicanus)* also occurs in rocky canyons. The canyon wren also gleans spiders, insects, and other small invertebrates and nests on rock ledges, shelves, and crevices, usually near water. Cliff swallow (*Petrochelidon pyrrhonota*) builds mud nests on rock overhangs and cliffs, but a source of mud must be nearby; this species is not widespread in the Plan Area. Some highly mobile birds use secluded rock outcrops and ledges for nesting, including golden eagle, prairie falcon, and common raven (*Corvus corax)*.

Of the mammals, several bat species use rock outcrops and crevices for day roosting sites. The bat species most strongly associated with rocky crevices include Yuma myotis (*Myotis yumanensis*), Californian myotis (*Myotis californicus*), long-legged myotis (*Myotis volans*), western pipistrelle (*Pipistrellus hesperus*), spotted bat (*Euderma maculatum*), and pocketed free-tailed bat (*Nyctinomops femorosaccus*), which must drop from a height to gain flying speed. Other bat species that use rock crevices include fringed myotis (*Myotis thysanodes*), western small-footed myotis (*Myotis ciliolabrum*), pallid bat (*Antrozous pallidus*), and Brazilian free-tailed bat (*Tadarida brasiliensis*). Other bat species that use caves, mines, and tunnels that are often associated with unvegetated areas are California leaf-nosed bat (*Macrotus californicus*) and Townsend's big-eared bat (*Corynorhinus townsendii*). The use of roost sites by bats in the Plan Area is not well understood, but several bat species have been recorded in various areas of the Plan Area. Californian myotis has been documented in southern Inyo County, eastern Kern County, and south-central San Bernardino County. The pallid bat and Townsend's big-eared bat have been documented in scattered locations throughout the Plan Area (see Sections 5.3.6 and 5.3.8 for full details). California leaf-nosed bat has been documented in several locations in the southern portion of the Plan Area (see Section 5.3.3). Several other species have been documented in a single area: big brown bat (*Eptesicus focus*) has been documented in northern Riverside County; Yuma myotis has

been documented in eastern Los Angeles County; and long-legged myotis has been documented in southern Inyo County.

Several other mammals are strongly associated with unvegetated habitats. Spiny pocket mouse (*Chaetodipus spinatus*) occurs in the Sonoran Desert and canyon mouse (*Peromyscus crinitus)* occurs throughout the Plan Area in rocky habitats. The canyon mouse burrows beneath rocks and in rock crevices. Among other habitats, bighorn sheep occur in scattered locations in steep and rugged rocky terrains associated with the many mountain ranges in the Plan Area. Bighorn sheep use rocky terrains for escape, bedding, and lambing, but move to more open and exposed habitats to foraged and access water. The rock squirrel (*Spermophilus variegatus*) is endemic to the Providence Mountains in the Eastern Mojave Desert where it uses rocky areas for burrows and dens.

Reptiles closely associated with rocky areas include chuckwalla (*Sauromalus ater*), Great Basin collared lizard (*Crotaphytus bincinctores*), rosy boa (*Lichanura trivirgata)*, and speckled rattlesnake (*Crotalus mitchellii*).

Playas are fairly devoid of vegetation due to highly alkaline soils but do provide unique and important seasonal wetland resources for a variety of migratory and wintering birds. For example, Searles Dry Lake east of Trona and Koehn Dry Lake northeast of California City have spring-fed wetlands that expand with winter rains that produce highly productive alkali meadows and mudflats (National Audubon Society 2011a). Harper Dry Lake near Barstow also provides wetland habitat for birds (BLM 2007). Thousands of migratory and wintering waterfowl and shorebirds are attracted to these wetland resources, including phalaropes (*Phalaropus* spp.), teal and pintail (*Anas* spp.), eared grebe (*Podiceps nigricollis*), American white pelican (*Pelecanus erythrorhynchos*), herons and egrets (Ardeidae), killdeer (*Charadrius vociferus*), stilts and avocets (Recurvirostridae), white-faced ibis (*Plegadis chihi*), northern harrier, and short-eared owl (National Audubon Society 2011a; BLM 2007). Snowy plover (*Charadrius alexandrinus*) has been documented to nest at Harper Dry Lake and Searles Dry Lake (Garrett and Dunn 1981; National Audubon Society 2011a). Raptors such as peregrine falcon (*Falco peregrinus*), which hunt for waterfowl, also occur in these areas and other predators, such as coyote, are attracted to these resources when large congregations of birds are present.

4.3.1.6 Scrub and Chaparral Community

The scrub and chaparral community makes up the majority of the Plan Area (approximately 55%). As shown in Table 4-1, desert scrub is composed of several macrogroups and groups. For the purpose of describing wildlife species associations, Joshua tree woodland is included

in this community type because it often occurs in a mosaic with desert scrub communities and these communities have many species in common.

The wildlife communities in desert scrub are quite diverse, but there are several species of birds, mammals, and reptiles that are distinctly representative of desert scrub. Generally, these species either do not occur outside of the desert scrub or if they do occur elsewhere, the desert is an important stronghold of their range, or the desert scrub is an important part of the life cycle (wintering habitat).

Bird species typically considered to be "desert species" and which commonly occur in desert scrub include Gambel's quail, white-winged dove (*Zenaida asiatica*), greater roadrunner (*Geococcyx californianus*), common poorwill (*Phalaenoptilus nuttallii*), Costa's hummingbird (*Calypte costae*), verdin, cactus wren (*Campylorhynchus brunneicapillus*), black-tailed gnatcatcher (*Polioptila melanura*), LeConte's thrasher (*Toxostoma lecontei*), green-tailed towhee (winter range), Abert's towhee, Brewer's sparrow (*Spizella breweri;* winter range), and black-throated sparrow. Bendire's thrasher (*Toxostoma bendirei*) occurs locally in Joshua tree woodland, as well as desert succulent scrub.

Mammals that are common, but generally limited to desert scrub in the Plan Area are almost all rodents. Most of the rodent species are kangaroo rats or pocket mice and several occur throughout the Mojave and Sonoran deserts, including Merriam's kangaroo rat, desert kangaroo rat, little pocket mouse, and long-tailed pocket mouse (*Chaetodipus formosus*). Other kangaroo rats and pocket mice are less widespread and more locally distributed, including Great Basin pocket mouse (*Perognathus parvus*), desert pocket mouse (Sonoran Desert and locally in Mojave Desert), spiny pocket mouse (primarily Sonoran Desert), chisel-toothed kangaroo rat (Mojave and Great Basin desert areas supporting shadscale), and Panamint kangaroo rat (*Dipodomys panamintinus*) (Mojave and Great Basin deserts). Other common rodents in the desert scrub communities include cactus mouse (*Peromyscus eremicus*), canyon deermouse, grasshopper mouse (*Onychomys torridus*), and desert woodrat (*Neotoma lepida*). The white-throated woodrat (*Neotoma albigula*) occurs throughout the Sonoran Desert. Several squirrel species occupy desert scrub in the Plan Area, but with the exception of the widespread white-tailed antelope squirrel, these species tend to have limited distributions. The round-tailed ground squirrel is also fairly widespread in the Sonoran Desert and Eastern Mojave Desert. The Mohave ground squirrel is limited to the western Mojave Desert in the eastern Kern, northeastern Los Angeles, western San Bernardino, and southwestern Inyo counties. The rock squirrel is limited to the Providence Mountains in the Eastern Mojave Desert. Two lagomorphs are common throughout the scrub communities—black-tailed jackrabbit and desert cottontail. Other "desert" mammal species that occur throughout the Plan Area in the desert scrub communities are Crawford's gray shrew (*Notiosorex crawfordi*) and kit fox.

A variety of reptile species occupy the desert scrub and woodlands in the Plan Area. Most notable among these is the desert tortoise, which occurs throughout most of the undisturbed and less disturbed areas of the Plan Area. Other reptile species commonly occurring in both the Mojave and Sonoran deserts include common chuckwalla, desert horned lizard, desert iguana, desert spiny lizard, long-nosed leopard lizard, zebra-tailed lizard, western groundsnake, western shovelnose snake (*Chionactis occipitalis*), and sidewinder. The Great Basin collared lizard occurs in the Mojave Desert and northeastern portion of the Sonoran Desert. Species generally restricted to the Mojave Desert include desert night lizard (*Xantusia vigilis*) and Mojave rattlesnake (*Crotalus scutulatus*). Species mostly limited to the Sonoran Desert include flat-tailed horned lizard (*Phrynosoma mcallii*) and western diamond-backed rattlesnake. The Gila monster (*Heloderma suspectum*) is restricted to a small area in northeastern San Bernardino County. Although some of these species are geographically widespread and common, they occur patchily within their range in specific microhabitats. For example, sidewinders often occur in sandy washes and windblown sand areas where they can burrow under the sand and wait for prey. The chuckwalla, on the other hand, is mostly restricted to the cover of rocky and boulder-strewn habitats. Generally, reptiles can be characterized as species associated either with flatter, open terrain with sandy soils (e.g., desert horned lizard, desert spiny lizard, long-nosed leopard lizard, zebra-tailed lizard, and Mojave rattlesnake) or with rocky and/or brushy and woody areas (e.g., chuckwalla, Great Basin collared lizard, desert night lizard, and western diamond-backed rattlesnake).

The more mesic coastal scrub and chaparral vegetation types have a limited distribution in the Plan Area and tend to occur at the mid-elevations of the mountain ranges that bound the desert portions of the Plan Area. The wildlife communities in the coastal scrub and chaparral support species that are more common in cismontane and coastal regions of Southern California and less tolerant of the harsh arid desert conditions.

Year-round resident species that typically only are found in the scrub and chaparral community include California quail (*Callipepla californica*), California thrasher (*Toxostoma redivivum*), wren-tit (*Chamaea fasciata*), California towhee (*Melozone crissalis*), spotted towhee, rufous-crowned sparrow (*Aimophila ruficeps*), and black-chinned sparrow (*Spizella atrogularis*). Certain small mammals are also fairly exclusive to coastal scrub and chaparral habitats, including dusky-footed woodrat (*Neotoma fuscipes*), Pacific kangaroo rat (*Dipodomys agilis*), Dulzura kangaroo rat (*Dipodomys simulans*), brush deermouse (*Peromyscus boylii*), California deermouse (*Peromyscus californicus*), California pocket mouse (*Chaetodipus californicus)*, San Diego pocket mouse (*Chaetodipus fallax*), and brush rabbit (*Sylvilagus bachmani*). Common reptiles found in scrub and chaparral habitats include common kingsnake (*Lampropeltis getula*), western rattlesnake, coachwhip, gophersnake, western fence lizard, western whiptail (*Aspidoscelis tigris*), and side-blotched

lizard. There are also a number of wildlife species that commonly occur in mesic coastal scrub and chaparral and that are also relatively common and widespread in desert scrub communities, including greater roadrunner, Costa's hummingbird, ash-throated flycatcher, cactus wren, blue-gray gnatcatcher (*Polioptila caerulea*), phainopepla (*Phainopepla nitens*), loggerhead shrike, sage sparrow (*Amphispiza belli*) (only winters in desert), black-tailed jackrabbit, desert cottontail, little pocket mouse (locally in sparse scrub with sandy soils and washes), cactus deermouse, North American deermouse (*Peromyscus maniculatus*), desert woodrat, bobcat (*Lynx rufus*), mountain lion (*Puma concolor*), and gray fox. Ringtail (*Bassariscus astutus*) also occurs throughout the state in riparian scrub, but is uncommon in the deserts and Southern California. Mule deer occur in both coastal scrubs and chaparral and in brushier habitats in the Mojave and Sonoran deserts. Reptiles tend to be more limited in distribution, but species that occur in both mesic coastal scrub and chaparral and the desert communities include common kingsnake, coachwhip, gophersnake, rosy boa, western patch-nosed snake, glossy snake (*Arizona elegans*), side-blotched lizard, and western whiptail.

4.3.1.7 Wetland Community

The wetland community covers approximately 1.4% of the Plan Area and includes alkali and freshwater marshes, as well as open water (Figure 4-1). This community provides important habitat for several taxa, and especially for birds, because they are valuable wetland habitat "islands" in an arid landscape that provide cover for nesting and concentrated food sources that do not occur elsewhere in the region.

Marsh habitats with dense stands of cattail (*Typha* spp.) provide nesting habitat for several bird species in the Plan Area, including least bittern (*Ixobrychus exilis*), clapper rail (*Rallus longirostris*), black rail (*Laterallus jamaicensis*), marsh wren (*Cistothorus palustris*), common yellowthroat, red-winged blackbird (*Agelaius phoeniceus*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), redhead (*Aythya americana*), ruddy duck (*Oxyura jamaicensis*), common moorhen (*Gallinula chloropus*), and American coot (*Fulica americana*) (Patten et al. 2003). Marsh habitats also provide foraging and/or resting and loafing habitat for many more avian taxa such as grebes (Podicipedidae); many species of herons, bitterns, and allies; ibises and spoonbills (Threskiornithidae), including white-faced ibis (*Plegadis chihi*); ducks and geese (Anatidae), including uncommon species such as wood duck (*Aix sponsa*); raptors such as northern harrier, and peregrine falcon; rails (Gruiformes) such as Virginia rail (*Rallus limicola*) and sora (*Porzana carolina*); stilts and avocets; sandpipers (Scolopacidae) such as solitary sandpiper (*Tringa solitaria*), western sandpiper (*Calidris mauri*), short-billed dowitcher (*Limnodromus griseus*), long-billed dowitcher (*Limnodromus scolopaceus*), and Wilson's snipe (*Gallinago delicata*); belted kingfisher; and swallows (Hirundinidae) (Garrett and Dunn 1981).

Amphibians expected to use marsh habitats in the Plan Area include Baja California treefrog, American bullfrog (*Lithobates catesbeianus*), Woodhouse's toad, and possibly Sonoran desert toad. The Baja California treefrog and bullfrog are widespread in most aquatic habitats in much of California, including desert areas. Woodhouse's toad occurs along the lower Colorado River, in orchards between Indio and the Salton Sea, and in irrigated lands in the Imperial Valley (Zeiner et al. 1988). The Colorado River toad is uncommon in the lower Colorado River area and irrigated areas of Imperial County (Zeiner et al. 1988).

At least two mammals may occur in marsh habitat associated with the Colorado River system – Arizona cotton rat (*Sigmodon arizonae*) and muskrat (*Ondatra zibethicus*) (Zeiner et al. 1990). The muskrat also may occur in marshy habitat elsewhere in the Plan Area such as the Salton Sea and at least two locations in southern Inyo County (Zeiner et al. 1990). The muskrat is primarily herbivorous and feeds on aquatic plants such as cattails and bulrush (*Schoenoplectus* spp.), but also preys on small vertebrates such as crayfish (Zeiner et al. 1990).

Marshes also support a variety of aquatic invertebrates that provide food for birds and mammals that nest and forage in the marshes. Carnivorous birds such as bitterns, herons and egrets, and rails prey on many invertebrates, including crayfish, insects, spiders, worms, slugs, and snails. They also take amphibians, small mammals, and reptiles in the vicinity of the marshes. Ducks such as redhead and ruddy duck and gallinues such as common moorhen and American coot are primarily herbivorous, feeding on tubers, foliage and stems, and seeds of aquatic plants, and algae, but also take some insects.

Several pupfish are known from aquatic and marshy habitats in the Mojave Desert, including Amargosa pupfish (*Cyprinodon nevadensis amargosae)*, Saratoga Springs pupfish (*Cyprinodon nevadensis nevadensis*), Shoshone pupfish (*Cyprinodon nevadensis Shoshone)*, which are subspecies of *Cyprinodon nevadensis*; and Cottonball Marsh pupfish (*Cyprinodon salinus milleri*) and Salt Creek pupfish (*Cyprinodon salinus salinus*), which are subspecies of *Cyprinodon salinus* (Moyle 2002).

Amargosa pupfish inhabit freshwater marsh in the Amargosa River in Amargosa Canyon and marshes associated with ditches that drain Tecopa Hot Springs and Tecopa Bore. These broad marshes support algae and emergent cattails and rush (*Juncus* spp.). The Saratoga pupfish only occurs in Saratoga Springs in the southeastern corner of Death Valley. The Shoshone pupfish historically occurred in Shoshone Springs, but is now confined to artificial refuges (Moyle 2002). These pupfish primarily feed on cyanobacteria and algae, but seasonally prey on small invertebrates such as chironomid larvae, ostracods, copepods, and mosquito larvae (Moyle 2002). They occur in areas where the water column velocities

are less than 2 centimeters (0.79 inches/second (Moyle 2002). Seasonal water temperatures range from 10 to 38°C (50 and 100°F) and may be close to freezing during severe winters; the maximum water temperature these pupfish can stand is about 42°C (108°F) (Moyle 2002).

In contrast to Amargosa pupfish, the Cottonball Marsh pupfish and Salt Creek pupfish are adapted to much more saline conditions that may be more than two times saltier than seawater at times. Both subspecies occur on the Death Valley floor – Salt Creek pupfish on Salt Creek in the northern part of Death Valley and Cottonball Marsh pupfish in a marsh adjacent to the sink for Salt Creek (Moyle 2002). Occupied pools are bordered by salt-tolerant plants, such as saltgrass (*Distichlis spicata*), and pickleweed (*Salicornia* spp.). The Salt Creek pupfish primarily feeds on algae and cyanobacteria, but the Cottonball Marsh pupfish, and likely the Salt Creek pupfish, also feeds on amphipods, ostracods, and small snails that occur on algal mats (Moyle 2002). Seasonal water temperatures range from near freezing to almost 40^{0}C (104°F). Salt Creek pupfish can tolerate water temperatures to up 38^{0} C (50°F) and survive in short-term exposure to 43^{0}C (109°F) (Moyle 2002). Salt Creek pupfish exhibit opportunistic, explosive population increases when water flows are high, possibly reaching peaks in the millions and measuring densities of 527 fish per square meter (Moyle 2002). The population peaks, followed by die-offs when waters recede, provide abundant food source for bird such herons and egrets and comment ravens (Moyle 2002).

The desert pupfish (*Cyprinodon macularius*) occurs in small isolated populations around the Salton Sea and Colorado River, in shoreline pools and irrigation drainages with quiet water conditions (Moyle 2002). They have also been introduced into sanctuaries in Anza-Borrego State Park and elsewhere. Desert pupfish are adapted to a wide range of habitat conditions, occurring in fresh water to highly saline conditions twice as salty as sea water and water temperatures ranging from 7^{0}C to 45^{0}C (45°F to 113°F) (Moyle 2002). During the winter, they bury themselves under loose debris and become dormant (Moyle 2002). They are opportunistic omnivores, feeding on algae, ostracods, copepods, aquatic crustaceans, insect larvae, and small snails.

4.3.1.8 Woodland Community

The woodland community comprises approximately 0.8% of the Plan Area (Figure 4-1). Wildlife inhabiting pinyon-juniper woodlands also often occur in chaparrals and coastal scrubs and/or desert scrubs, but a few species are closely associated within pinyon-juniper woodlands. Bird species typical of the woodland communities in the Plan Area, but that are also commonly found in other vegetation types include Brewer's sparrow, black-chinned sparrow, western scrub-jay (*Aphelocoma californica*), oak titmouse (*Baeolophus inornatus*),

bushtit (*Psaltriparus minimus*), Bewick's wren (*Thryomanes bewickii*), loggerhead shrike, crissal thrasher, gray-headed junco (*Junco hyemalis caniceps*), ladder-backed woodpecker (*Picoides scalaris*), ash-throated flycatcher, Cassin's kingbird, mountain chickadee (at higher elevations), blue-gray gnatcatcher, black-throated gray warbler (*Dendroica nigrescens*), and Scott's oriole (*Icterus parisorum*). Species that are somewhat limited to pinyon-juniper woodland include pinyon jay, which breeds in pinyon, but may forage in shrublands and grassland; juniper titmouse (*Baeolophus ridgwayi*), which occurs in the north and northeastern portions of the Mojave desert; hepatic tanager (*Piranga flava*), which is a rare summer resident in pinyon-juniper woodland on Clark Mountain, in the Kingston Mountains, the New York Mountains, and the northeastern San Bernardino Mountains; and gray vireo (*Vireo vicinior*), which also require dense stands of chaparral near pinyon-juniper woodlands (Garrett and Dunn 1981; Small 1994).

During the winter months, large numbers of birds forage on the juniper berries, including robins (*Turdus migratorius*), cedar waxwings (*Bombycilla cedrorum*), western bluebirds (*Sialia mexicana*), and evening grosbeaks (*Coccothraustes vespertinus*) (Small 1994). The pinyon pine nuts are important food for the pinyon jay and Clark's nutcracker during the winter (Small 1994).

The CDFG Species of Special Concern pallid San Diego pocket mouse (*Chaetodipus fallax pallidus*) occurs in pinyon-juniper, as well as scrubs and chaparral in the Peninsular Ranges. Other relatively common mammals occurring in pinyon-juniper woodland, as well as other vegetation types, are black-tailed jackrabbit, brush rabbit, desert cottontail, Pacific kangaroo rat, California pocket mouse, dusky-footed woodrat, desert woodrat, as well as several deermouse species. Large mammals include mule deer, mountain lion, and bobcat. As with birds and mammals, the reptiles found in pinyon-juniper woodland are often found in other vegetation types at lower and higher elevations. Snakes expected to occur in pinyon-juniper woodlands include rosy boa, glossy snake, California striped snake (*Coluber lateralis lateralis*), speckled rattlesnake, red diamond rattlesnake (*Crotalus ruber*), and western rattlesnake, among others. Lizards expected to occur include western fence lizard, side-blotched lizard, coast horned lizard (*Phrynosoma blainvillii*), and western whiptail.

Oak woodlands provide important breeding and foraging habitat for a variety of species, particularly birds. Birds characteristic of oak woodlands and forests include acorn woodpecker (*Melanerpes formicivorus*), Nuttall's woodpecker (*Picoides nuttallii*), northern flicker (*Colaptes auratus*), white-breasted nuthatch (*Sitta carolinensis*), western scrub-jay, oak titmouse, band-tailed pigeon (*Patagioenas fasciata*), and Hutton's vireo (*Vireo huttoni*) (Small 1994). Acorns are an important food source for several common bird species, including acorn woodpecker, western scrub-jay, and oak titmouse. Caching of acorns by scrub jays also promotes oak regeneration and recruitment. Understory shrubs and

herbaceous vegetation in oak woodlands and forests also provide other food resources for native species, including arthropods, fruits, and seeds. Most of the birds associated with woodlands and forests use the trees for roosting, perching, refuge, or nesting. Nesting cavities and snags in woodlands and savannahs are particularly important for acorn woodpecker, oak titmouse, and western bluebird, as well as the special-status purple martin (*Progne subis*). Large oak trees provide nesting and roosting habitat for several raptors, including golden eagle, red-tailed hawk, red-shouldered hawk (*Buteo lineatus*), and American kestrel. Mammals such as mule deer, gray fox, bobcat, and common raccoon use woodland and forests for cover, refuge, and movement. Gray squirrels (*Sciurus griseus*) rely on woodlands for cover, nesting cavities, and acorns as a food source. The understory of woodlands and savannahs provides herbaceous and leaf-litter cover and food resources for a variety of small species, including various mice and reptile species.

4.3.1.9 Other Land Covers

Agricultural Areas

Agricultural areas are mapped over approximately 3.4% of the Plan Area and are concentrated in three main regions: the Imperial Valley south of the Salton Sea, the Palo Verde Valley in the Blythe region, and the Antelope Valley in the western Mojave Desert (Figure 4-1). Generally, all three areas provide important wintering and migration habitat for many bird species, especially shorebirds.

The agricultural fields in the Imperial Valley attract a large number of birds that visit the Salton Sea during migration and for wintering. Many of these species forage and rest in the agricultural fields and use the irrigated fields and associated canals and ditches. Food sources in these agricultural fields can be abundant, especially when disking or grazing unearths or flushes various terrestrial insects, such as crickets, grubs, and grasshoppers. Waste grain provides food sources for seed-eaters such as blackbirds, goldfinches, and sparrows (Small 1994). The agricultural fields in the Imperial Valley are particularly important habitat for many water birds (including shorebirds), as well as other avian species. In 1999, Shuford et al. (2000) recorded 38,398 individuals of at least 63 bird species over 12 monthly surveys in agricultural fields in the northern Imperial Valley. The three dominant species observed during this study were ring-billed gull (*Larus delawarensis*) (12,092 individuals), cattle egret (*Bubulcus ibis*) (10,862 individuals), and red-winged blackbird (4,034 individuals), accounting for 70% of all the birds counted. Other relatively common species detected (i.e., more than 100 individuals counted), in descending order of abundance, were white-faced ibis, snow/Ross's goose (*Chen* spp.), long-billed curlew (*Numenius americanus*), black-necked stilt (*Himantopus mexicanus*), black tern (*Chlidonias niger*), swallow spp., killdeer, laughing gull (*Leucophaeus atricilla*),

western meadowlark, least sandpiper (*Calidris minutilla*), black-bellied plover (*Pluvialis squatarola*), whimbrel (*Numenius phaeopus*), Brewer's blackbird (*Euphagus cyanocephalus*), American pipit (*Anthus rubescens*), Wilson's phalarope (*Phalaropus tricolor*), greater yellowlegs (*Tringa melanoleuca*), tree swallow, horned lark, American kestrel, and yellow-headed blackbird. Fourteen of the 20 most abundant taxa in agricultural fields were shorebirds (Shuford et al. 2000). Agricultural fields with a grass component were the most frequently used, accounting for 39% of all birds, followed by alfalfa fields with 31% and bare fields with 24% of birds. Most of the activity in the fields was feeding (65%), followed by resting (23%), and flying (10%) (Shuford et al. 2000). Periodic burning of fields, such as asparagus, provides particularly valuable habitat for wintering mountain plovers (*Charadrius montanus*), horned larks, and American pipits (Patten et al. 2003).

The canals and drainage ditches in the Imperial Valley also provide extremely important habitat for the burrowing owl, which supports one of the largest breeding populations in California. There were an estimated 5,600 pairs (range 3,405 to 7,775) in Imperial Valley during 1992 and 1993 (Gervais et al. 2008). This estimate dropped to 4,879 pairs in 2007 and 3,557 pairs in 2008. Burrowing owls in this region nest along the soft earthen embankments of canals and ditches and roads in areas surrounded by crops, and about 80% of foraging occurs within about 1,950 feet of the nest burrow (Gervais et al. 2008).

In addition to burrowing owl and American kestrel, other raptors also commonly forage in agricultural fields, including barn owl (*Tyto alba*), great horned owl, and northern harrier, as well less commonly occurring raptors such as merlin, ferruginous hawk, and Swainson's hawk (Patten et al. 2003). Rodents, including ground squirrels and pocket gophers (*Thomomys bottae*), and large invertebrates may be abundant on agricultural lands and attract foraging raptors.

The Palo Verde Valley supports fewer numbers of birds compared to the Imperial Valley due to the Imperial Valley's proximity to the Salton Sea and substantially more agriculture. However, the close proximity of the Palo Verde Valley to the Colorado River makes this area an important migration route and the adjacent agricultural fields in the area provide important habitat for migrant shorebirds when flooded, including large numbers of mountain plover, whimbrel (numbering up to 10,000 in the spring), and long-billed curlew (National Audubon Society 2011b).

The Antelope Valley in the Western Mojave Desert also supports a substantial amount of agriculture, although on a much smaller scale than the Imperial and Palo Verde valleys. Alfalfa fields in the Antelope Valley are important foraging habitat for the small local breeding population of Swainson's hawk, a state-listed threatened species, because they

provide a consistent level of available prey such as ground squirrels, pocket gophers, grasshoppers, and crickets (Woodbridge 1998). The agricultural fields, especially alfalfa, also support mountain plover, and fields that receive effluent from local water treatment facilities can support hundreds of white-faced ibis, long-billed curlew, and other shorebirds in the fall and winter (National Audubon Society 2011c). Ferruginous hawk, mountain bluebird (*Sialia currucoides*), and horned lark also use agricultural fields in the Antelope Valley (Hood 2007)..

Although birds are by far the largest vertebrate group to use agricultural lands in the Plan Area, other vertebrate wildlife taxa expected to use agricultural lands include mammals and some amphibians and reptiles. As discussed previously, small mammals such as ground squirrels and pocket gophers may be abundant and reliable prey for raptors in agricultural areas. Coyotes may also hunt for these prey in agricultural areas. Common muskrat and hispid cotton rat (*Sigmodon hispidus*) are common along irrigation and roadside ditches associated with agricultural areas in the Imperial and Palo Verde valleys (Zeiner et al. 1990). The common muskrat feeds mostly on aquatic plants and aquatic invertebrates. The hispid cotton rat feeds on grasses and invertebrates, but also on sugar beets and other crops. The Arizona cotton rat occurs in agricultural areas along the lower Colorado River and feeds on sugar beets, grains, and other crops (Zeiner et al. 1990). Several bat species have geographic ranges that overlap the three main agricultural areas. While most bats primarily forage in natural habitats (e.g., scrubs, chaparral, woodland, forest, desert wash and riparian areas), they also may be attracted to agricultural fields for insect prey, including moths, dragonflies, damselflies, grasshoppers, crickets, mantises, walking sticks, true bugs, beetles, ants, wasps, and bees. Bat species that may occur throughout the Plan Area and that may forage in agricultural areas include big brown bat, Brazilian free-tailed bat, Californian myotis, pallid bat, spotted bat, Townsend's big-eared bat, and western pipistrelle. Bats that may occur more locally in the Plan Area and forage in agricultural areas include California leaf-nosed bat in the Sonoran and Eastern Mojave deserts; pocketed free-tailed bat and western yellow bat (*Lasiurus xanthinus*) in the Sonoran Desert; and Yuma myotis and western red bat (*Lasiurus blossevillii*) along the Colorado River.

Agricultural operations provide aquatic breeding and foraging habitat for amphibians, and several common and at least two invasive species occur in the Plan Area. Ponds and irrigation ditches provide suitable aquatic breeding habitat and the adjacent fields provide abundant invertebrate prey taken by amphibians, including grasshoppers, crickets, moths, caterpillars, beetles, ants, sow bugs, scorpions, centipedes, and spiders. The native amphibian species that occur in ponds and irrigation ditches in agricultural areas are primarily limited to the Imperial Valley and lower Colorado River, and include Woodhouse's toad, great plains toad, and Couch's spadefoot (lower Colorado River). The non-native Rio Grande leopard frog, which is native to Texas, New Mexico, and Mexico, may

have been accidentally introduced in the Yuma area between 1965 and 1971 during fish plants, and has expanded its range into the agricultural areas of the Imperial Valley (CaliforniaHerps 2011). The non-native American bullfrog occurs throughout the Plan Area in suitable habitat.

Agricultural areas support a limited number of reptile species, although some may be attracted to agricultural areas for small rodent prey and larger invertebrates, especially if the agricultural area is adjacent to natural habitat that provides adequate refuge and shade (e.g., rocks, shrubs). Snakes in particular are highly vulnerable to mortality from farm equipment, vehicle collisions, and human control and eradication. Snakes that may sometimes occur in agricultural areas, especially areas with grasses, include California kingsnake, coachwhip, gophersnake, western groundsnake, checkered gartersnake (*Thamnophis marcianus*), and western diamond-backed rattlesnake. The side-blotched lizard is the only lizard expected to commonly use agricultural areas for foraging and refuge (e.g., in rodent burrows), but some other common lizard species that occur in desert scrub and wash habitats may occasionally forage along the habitat boundary between natural habitat and agriculture.

Developed and Disturbed Areas

Developed areas are mapped over approximately 1.7% of the Plan Area and include low- to high-intensity urban development and open space associated with developed areas, including uses such as golf courses (Figure 4-1). Rural areas cover approximately 3.4% of the Plan Area and include areas of rural development. Areas mapped as disturbed lands cover approximately 0.1% of the Plan Area. Developed and disturbed areas can support a mix of native desert species that are adapted to urban and rural settings and several non-native species that have naturalized in these settings. Some common wildlife in the more highly developed urban setting include at least two very common non-native birds, house sparrow (*Passer domesticus)* and European starling (*Sturnus vulgaris)*, and one non-native rodent, the house mouse (Pavlik 2008). Common native birds in developed desert settings include house finch, mourning dove, white-winged dove, Costa's hummingbird, northern mockingbird, Brewer's blackbird, great-tailed grackle, and common raven (Small 1994; Behrends, pers. obs. 1978–1986). In addition to these common urban-adapted species, native bird species that commonly occur in lower density desert urban, rural settings, native plant gardens, and along the edges of golf courses include red-tailed hawk, American kestrel, American roadrunner, Gambel's quail, American robin, western meadowlark, barn owl, screech owl ( ), western and Cassin's kingbird, verdin, and cactus wren (Weathers 1983; Behrends, pers. obs. 1978–1986). Other wildlife commonly occurring within or near developed areas include coyote, deer mice, Merriam's kangaroo rat, pocket mice, woodrat, round-tailed squirrel, side-blotched lizard, gophersnake, coachwhip, and rattlesnake (P.

Behrends, pers. obs. 1978–1986). Water features, primarily associated with golf courses, attract migrating waterfowl (e.g., ducks, geese, grebes, loons) and shorebirds (Weathers 1983; P. Behrends, pers. obs. 1978–1986). Irrigated landscaped areas, such as golf courses and parks, are a magnet for migrating land birds.

4.3.2 Floral Richness and Diversity

The California desert flora includes approximately 2,267 minimal-rank plant taxa (i.e., species, subspecies, and varieties) that are native to California, comprising about 37% of the total flora in California (Baldwin et al. 2002). About 232 taxa (10%) in the California deserts are non-native, which is relatively less than the 15% of California total taxa that are non-native (Baldwin et al. 2002). The Mojave Desert in California has about 1,409 native taxa, compared to 1,363 native taxa in the southern Great Basin Province and 709 native taxa in the Sonoran Desert (Baldwin et al. 2002). The higher level of plant diversity in the Mojave and Great Basin deserts compared to the Sonoran Desert reflects the greater climatic and elevation diversity of these regions.

4.3.3 Faunal Richness and Diversity

Similar to the vegetation communities and floral richness and diversity, the desert regions of the Plan Area also support a high diversity of animal species.

4.3.3.1 Birds

Birds comprise a very large component of the faunal richness and diversity, in large part because of the Salton Sea, Colorado River, and adjacent irrigated agricultural fields that attract large numbers of birds during migration and for wintering. Even excluding the Salton Sea and adjacent agricultural lands, the BLM California Desert Checklist of Birds (Foreman and Nicolai 2011) includes almost 300 species representing about 39 separate taxonomic groups (e.g., hawks, kites, and eagles, owls, hummingbirds, swallows, finches, and sparrows). Of these approximately 300 species, a much smaller number are commonly found in the most arid habitats that make up the vast majority of the Plan Area because most avian nesting and wintering species are limited to areas where food and water or vegetation is readily available. Audubon California has identified 22 Important Bird Areas in the DRECP boundary.[1] A more detailed discussion of the avian species typically occurring in the different natural communities is provided in Section 4.3.1.

[1] Important Bird Areas are sites that provide essential habitat for one or more species of bird and must satisfy certain criteria to qualify.

4.3.3.2 Mammals

The Plan Area is within or intersects with the geographic ranges of about 75 mammal species (Ingles 1965). The largest group of mammals occurring in the Plan Area is rodents (Rodentia), comprising approximately 34 species. The rodent group includes about 12 species of kangaroo rats (*Dipodomys* spp.), kangaroo mice (*Microdipodops* spp.), and pocket mice (*Perognathus* and *Chaetodipus* spp.); about 12 species of "old world rodents" (Muridae), including western harvest mouse, woodrats (*Neotoma* spp.), deer mice (*Peromyscus* spp.), voles (*Microtus* spp.), muskrat; about six squirrel and four chipmunk species (Sciuridae), and two gopher species (*Thomomys* spp.). Bats (Chiroptera) comprise the second largest group, with approximately 19 species, including species from the Phyllostomidae (leaf-nosed bats), Verspertionidae (evening bats), and Molossidae (free-tailed bats) families. Approximately six shrew species (Insectivora) occur in the Plan Area. Eleven carnivore (Carnivora) species occur in the Plan Area, including mountain lion, bobcat, coyote, kit fox, American black bear (*Ursus americanus*), raccoon, ringtail, weasel, and American badger. Four ungulates occur in the Plan Area, including elk (*Cervus elaphus*), bighorn sheep, pronghorn (*Antilocapra americana*), and mule deer. A more detailed discussion of the mammal species typically occurring in the different natural communities is provided in Section 4.3.1.

4.3.3.3 Reptiles and Amphibians

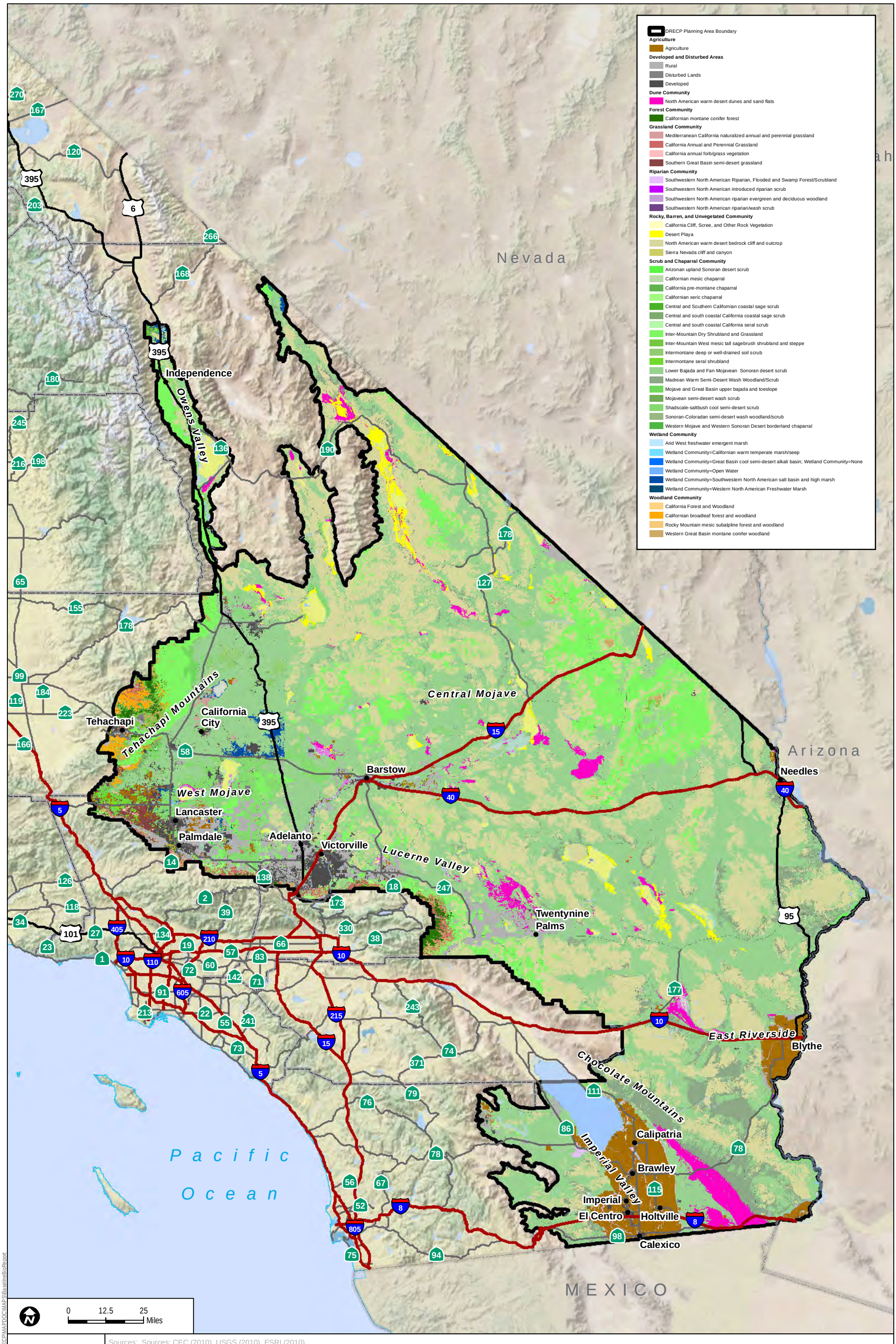
Approximately 70 reptiles and amphibian species have geographic ranges within the Plan Area. The largest group of reptiles is snakes, which comprise about 27 species from the Boidae (boas), Colubridae (egg-laying), Leptotyphlodipae (blind snakes), and Viperidae (vipers) families. The lizards comprise approximately 23 species from several families, including Anguidae (alligator lizards), Phrynosomatidae (e.g., horned, fringe-toed, spiny, sagebrush, and fence lizards), Iguanidae (chuckwalla, desert iguana), Crotophytidae (collared and leopard lizards), and Xantusa (night lizards). There are four tortoises and turtles with ranges in the Plan Area, including desert tortoise, western pond turtle (*Actinemys marmorata*), Sonora mud turtle (*Kinosternon sonoriense*), and spiny softshell (*Apalone [Trionyx] spinera*). There are three gecko species (*Coleonyx* spp. and *Phyllodactylus xanti*) and two skink species (*Eumeces* spp.) with ranges in the Plan Area. Although the Plan Area is arid, about 14 amphibian species occur, including several salamanders (Salamandridae [newts] and Plethodontidae [lungless salamanders], spadefoot toads [Pelobatidae, true toads [Bufonidae], and tree frogs [Hylidae], and true frogs [Ranidae]). A more detailed discussion of the reptile and amphibian species typically occurring in the different natural communities is provided in Section 4.3.1.

4.3.3.4 Invertebrates

The total number and diversity of arthropods, including crustaceans (e.g., fairy shrimp), insects, centipedes, millipedes, and arachnids and gastropods (snails and slugs) in the Plan Area is unknown and impossible to estimate because many groups of arthropods and gastropods have not been studied. However, studies have shown high species richness and endemism levels resulting from microhabitat specialization associated with unique substrates, host plants, and water sources (CDFG 2010a). For example, more than 2,500 invertebrate taxa have been identified at the Deep Canyon Desert Research Center, which is primarily Sonoran Desert on alluvial fan and rocky slopes, but also supports montane forest, chaparral, high desert plateau, pinyon-juniper woodland, ephemeral streams, and permanent waterholes (UCR 2005). With respect to endemism, CDFG (2010a) reports that 22 of 29 invertebrate taxa known from the Mojave Desert that are on the Special Animals List are endemic to the Mojave Desert. Similarly, 8 of 15 invertebrate taxa known from the Sonoran Desert that are on the Special Animals List are endemic to the Sonoran Desert (CDFG 2010a). A more detailed discussion of invertebrates known from the different natural communities is provided in Section 4.3.1.

4.3.3.4 Fish

Because fish are limited to aquatic habitats, they are not widespread in the Plan Area. However, approximately 35 taxa are known from the Sonoran Desert and 19 taxa are known from the Mojave Desert (CDFG 2010a). Several of these fish taxa are included on the Special Animals List because of their high level of endemism or because of other threats and environmental stressors. Special-status fish in the Mojave Desert include Amargosa pupfish, Saratoga Springs pupfish, Shoshone pupfish, Cottonball Marsh pupfish, Salt Creek pupfish, Mohave tui chub (*Siphateles bicolor mohavensis*), arroyo chub (*Gila orcutti*), Amargosa Canyon speckled dace (*Rhinichthys osculus* ssp. *1*), and Owens speckled dace (*Rhinichthys osculus* ssp. *2*). Special-status fish known from the Sonoran Desert include desert pupfish, razorback sucker (*Xyrauchen texanus*), and bonytail (*Gila elegans*), the latter two of which are federally and state-listed endangered and occur in the Colorado River.



Sources: Sources: CEC (2010), USGS (2010), ESRI (2010)

DUDEK ICF INTERNATIONAL

FIGURE 4-1

Land Cover

Desert Renewable Energy Conservation Plan (DRECP) Baseline Biology Report

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APPENDIX E

ALTERNATIVE SOURCES OF RENEWABLE ENERGY IN IMPERIAL COUNTY

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Alternative Sources of Renewable Energy In Imperial County

This technical memorandum presents the results of research conducted by AECOM on the potential to develop alternative sources of renewable energy within Imperial County. This analysis focuses on types of renewable energy beyond the traditional sources, such as geothermal, wind, and solar. This analysis is based on the grant awarded to the County of Imperial for the update of the existing Geothermal Element of their General Plan. This technical memorandum describes the characteristics, physical requirements, and feasibility of developing these alternative sources of renewable energy in Imperial County. The results of this technical memorandum will be used in the suitability analysis for the development of renewable energy facilities presented in the Baseline Environmental Inventory Report.

Deep Solar Ponds and Hyper-Saline Brine Ponds

A salty and shallow body of water may present a unique opportunity for an on-demand source of renewable energy. In salty and shallow bodies of water, both natural and man-made, high salinity water may sink to the bottom with the less saline water rising to the top, virtually stopping convection, decreasing heat loss through evaporation, and creating a high temperature gradient from the surface to the bottom of the body of water with the temperature of the brine at the bottom potentially approaching the boiling point. When this occurs, the high water temperature on the bottom can be used to heat a working fluid that is used to run an organic rankine cycle generator utilizing an expansion turbine like in a conventional steam power plant.

The Salton Sea has a maximum depth of the about 50 feet. Unfortunately, data has shown[1] that there does not appear to be a permanent layering or stratification of temperature in this body of water, said another way, there is no temperature gradient to take advantage of. There is a temporary stratification that occurs following periods of no wind, but it is opposite of that typical of solar ponds, meaning the temperature on the bottom of the Salton Sea is typically cooler than the surface temperature[2]. Furthermore, the maximum water temperature in summer approaches but does not exceed 100° Fahrenheit, far from reaching typical solar pond temperatures of around 212° Fahrenheit. The lack of suitability of the Salton Sea serving as a solar pond is likely due to its large size and depth, as solar ponds are ideally only around 10 feet in depth.

[1] *"The Salton Sea. Physical and Chemical Characteristics"*, Lars. H Carpelan, University of Riverside
[2] *"Chemical and Physical Limnology of the Salton Sea, California – 1999"*, Holdren and Montano, USDOR

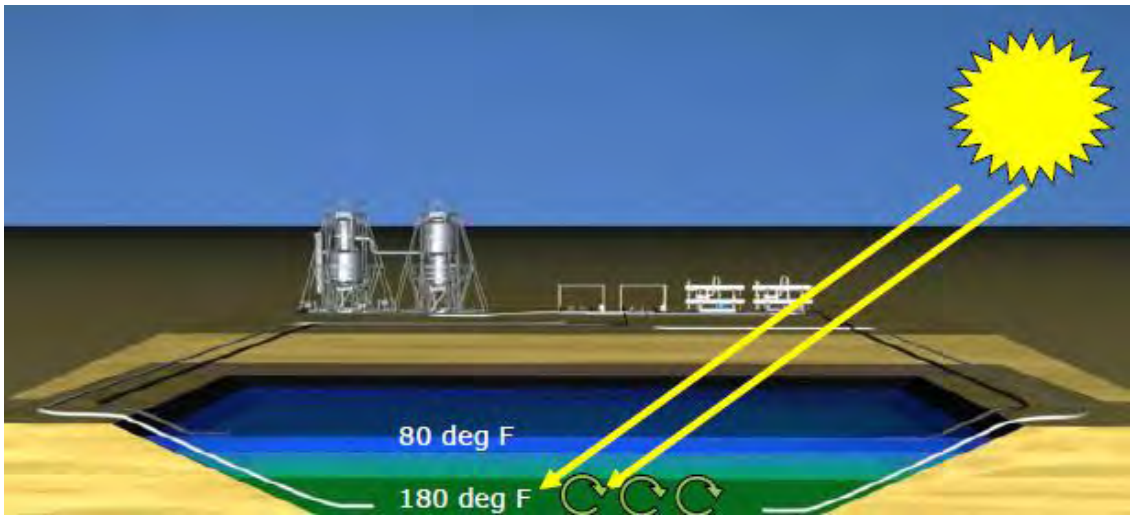

Figure 1. Cross Section of Solar Gradient Pond, Source: Sephton Water Technologies, Inc.

Nonetheless, man-made solar ponds require lots of land and high solar irradiance, both of which are plentiful in Imperial County. Man-made solar ponds typically employ sodium chloride (NaCl) and magnesium chloride (MgCl) as salts and have three distinct and stratified layers of salinity: the top layer has a low salinity and is convective; the middle layer is about four times the thickness of the top layer, is about 3 feet, is non-convective and stable; and the bottom where the energy is stored is as saline as possible and is convective. The total thickness depends on factors such as the maximum design temperature, the amount of energy to be stored and the availability of salt. The total depth of a solar pond, no matter the scale, whether for research or utility energy production purposes is about 30-40 feet. A dark colored rubber is usually used to line the pond and prevent leaching of salts into the surrounding soil. A study performed by JPL[3] at CalTech in 1982 found the Salton Sea water to be suitable as a started feed stock in order to establish utility scale solar ponds. Brine water from local geothermal power plants is also suitable for solar ponds.

Deep solar ponds are typically salt-less and covered with double glazing. At night, or when solar energy is not available, insulation is placed on top of the glazing in order to prevent heat loss. They also differ from salty solar ponds in that they require more substantial insulation around the bottom of the pond.

There are only two known examples of commercial solar ponds to have ever operated in parallel with an electric grid, both built and operated at the Dead Sea in Israel. The overall efficiency of the plant was less than 1% in terms of converting solar energy into electricity. The first system measured 75,000 square feet in area, with a depth of 8 feet, and had a rated capacity of 150 kW. The second system utilized a 5 MW turbine and was supposed to cover 250 acres, but only one quarter of that was built. The project was built at a cost of around $20,000,000. Fresh water requirements for the pond surface made operating

[3] *"Salton Sea Project Phase 1,"* M.L. Peelgreen, Jet Propulsion Laboratory, Jan 1982

costs high. After a long-term demonstration, the government stopped funding the project in 1991. With no private investors willing to take over, the project was ended. There is not a significant amount of literature alluding to why this technology has not achieved commercial success. However energy conversion efficiency based on the Carnot heat engine equation would indicate that such a small temperature gradient between the source and the sink may lead toward an inefficient mechanism for producing electricity. The University of Texas at El Paso has performed research on solar ponds and built a 70 kW test facility. They identified a few of the impediments to implementation as being the demonstration of reliable linings for the ponds, as well as suitable sites which they define as those with high solar output, which is not a constraint in Imperial County. Most importantly however, it was found that convection can occur in the pond, thereby destroying the saline and temperature gradient and rendering the pond useless. Since solar ponds retain their heat after the sun goes down, they do have an advantage in providing renewably generated electricity in the hours after traditional photovoltaics stop producing. The larger of the two projects at the Dead Sea was intended to occupy 50 acres/MW although the one quarter of the area was used, or about 12 acres/MW thereby decreasing the full load hours that would have been otherwise available. As a comparison, solar photovoltaics typically provide about double the capacity per unit area. The JPL study determined that a 600 MW utility scale solar pond power plant would occupy approximately 35,000 acres. The study also pointed out that brine production for only 250 acres of solar ponds would require 5 years of evaporating Salton Sea water and 625 acres of evaporation ponds, but that a partially filled storage layer would allow energy production to begin. Furthermore, outside of a few small research and development projects, there does not currently seem to be significant investment on behalf of either the private or public sector in the technology.

Figure 2. Solar Pond at A) the Dead Sea, Israel; B) RMIT University, Melbourne, Australia

There are two firms active in the field that were investigated. Both firms have active solar gradient pond projects in operation, however neither facilities are used to produce electricity. One of the firms' project is active at the Salton Sea where their primary activity is to remove salts from the Sea and provide desalinated water back to the Sea in order to assist in environmental remediation. In terms of job creation and establishing a stream of revenue, until electricity generation is more commercially viable, the project at the Salton Sea may find salt production for human consumption as a stepping stone. Man-made solar ponds also provide added environmental benefits around the area of the Salton Sea in

supressing air borne dust storms by covering dried lake beds. In terms of siting, access to appropriate brine is important in order to keep costs down by avoiding the import of brine salts to solar ponds. The areas around the Salton Sea thus assist in that respect. Access to utility transmission and road infrastructure are required as for any other utility scale power plant.

Solar gradient ponds are not expected to give off any noxious odors, as there is no chemical refining taking place. The extent of noises that a solar pond power plant would produce would come from the generators and would be similar in audible levels to generators of a similar rated PV plant at similar capacity. Dampening by way of concrete reinforced building walls may help to attenuate the noise levels if located close to residential or commercial areas.

Biofuels

A biofuel is essentially the same as a fossil fuel except that fossil fuels are ancient, accumulated over millions of years, while biofuels are produced from presently living organisms. Biofuels are generally produced from plants, algae, or animal fats. As those living organisms may consume carbon dioxide during their growth, biofuels have the added benefit that they may be carbon neutral.

Alcohol Biofuels

The most common biofuels today are alcohol fuels, most commonly ethanol, produced by fermentation of sugars in plants such as wheat, corn, sugar beets, sugar cane, molasses, potatoes or fruit waste and biodiesel produced by transesterification of feedstock such animal fats, vegetable oils, soy, rapeseed, jatropha, mahua, mustard, flax, sunflower, palm oil and hemp. While these fuels are beneficial for their potential use as transportation fuels, they require arable land and thus may compete with food sources. They also have a small net gain in energy output compared to that required for their production and as a result are not economically superior to fossil fuel options. Biofuel generation from plants typically require fresh water. Despite their fresh water needs, arable land requirements, and small net gain in energy output, alcohol fuels and biodiesels have been very successful commercially, the most notable example of which is Brazil's ethanol production which relies on sugarcane feedstock. Some have cited Brazil as able to sustain a biofuel economy because it is endowed with enormous amounts of arable land. Significant investments in technology and research and development by both the public and private sector have helped the Brazil ethanol success story as well.

Algae-Based Oil (Hydrocarbon Equivalent) Production

Algae based biofuels present a unique opportunity in that they may be grown in a controlled environment and make use of non-arable land that may have no other commercial purpose. Some algae based biofuel technologies do not need fresh water, but rather can function with salt water or non-potable water and can successfully produce freshwater as a by-product. Companies focused on algae-to-energy technology are aiming to produce various fuels including ethanol, jet fuel, diesel and other hydrocarbon equivalents. None of these firms are yet producing biofuels in commercial quantities; the largest operation of the algae-to-energy start-ups that were researched for this report is designed to produce 100 barrels of crude a day. One of the more heavily funded start-ups estimate they can produce 7,000 gallons of ethanol per acre per year using "bags" of algae as shown in Figure 3. Like solar ponds, this technology is yet to be proven commercially as cost competitive, however private and public investment in these technologies has been significant, continues to be invested in, and shows promise. Since algae-to-energy technology is water intensive where the proximity to water resources should be a consideration in the development of energy producing facilities. High amounts of sunshine are important as well for algae fuel production, of which is abundant in Imperial County. Lastly simple terrain is preferable for siting facilities as opposed to complex hilly terrain.

Figure 3. Algenol Array of Algae Filled Bags

Algae based oil production is another technology on the horizon which may be of interest to Imperial County. It is anticipated that in order to provide algae-based oil in the quantities that a fossil fuel based oil field produces, hundreds of thousands of acres of land would be necessary. While the level of investment to realize such an operation is not yet available, the same technology can be used to grow high value algae feedstock for fish, animal, and human consumption, providing an immediate revenue stream and stepping stone to algae as an oil producer. Algae products for animal and human consumption present an environmentally benign technology from the standpoint that the manufacturer provides virtually no industrial process noises nor noxious odors or emissions, in fact these process are likely to produce a fresh sea scent.

Algae's high demands for CO2 require access to some sort of facility with excess CO2, an industrial site or a geothermal plant. A refinery for an algae based oil would be of the same size as any other chemical refinery. The noises and emissions one would expect from an algae to oil refinery are similar to other chemical refineries. There would certainly be industrial process noises and there may be the potential for odors and emissions from the refining processes. The exact extent is hard to quantify at this time as no large scale algae to oil refineries exist. Pipelines would be necessary in order to move the oil out of the refinery. While the Salton Sea may provide the water source, only 75% of the water is currently recycled, with the remaining 25% going to evaporation ponds. Waste salts as a result of the evaporation would need to be taken to a landfill. It may be possible to co-locate an algae-based oil facility's evaporation pond to a solar pond so that the solar pond may make use of the waste salt products. While for feedstock production only, normal low voltage distribution lines will suffice as well as local roads, for a large scale algae-based oil facility, high traffic volume roads and medium voltage transmission power lines would be required infrastructure. Because algae facilities are also highly monitored facilities in order to maintain optimal operating conditions for algae growth, fiber optic and high quality IT infrastructure are also required. Land siting requirements are similar to that of solar ponds. Low quality land that offers no other value to the local community is often preferred so as to avoid conflicts in development. Besides relatively flat land, large expanses of land are best.

Imperial County is seen by algae growers as one of the best places in the world for production due to high levels of sunshine, as well as moderate year-round temperatures which rarely drop to freezing and thus do not threaten to kill algae stocks because of a single cold night. The region is also free from pests that may consume algae products.

Concentrated Solar

Concentrated solar typically refers to two types of technologies, Concentrated Solar-thermal Power (CSP) and Concentrated Photovoltaics (CPV). While there are many designs for CSP power plants, all use mirrors to reflect sunlight in order to increase the temperature on a specific location. All CSP plants use intensified sunlight in order to heat a working fluid through a heat exchanger to create steam and run a conventional steam turbine. CSP power plants have been in use since the early 1970's in California and Nevada. Those early plants were based on a trough that was a parabolic mirror with a heat transfer fluid filled tube in the focal point. This design is still being used for many projects worldwide. The troughs are about 30 feet at their highest point, and run hundreds of feet long. Troughs typically need very flat land due to the long straight arrays of mirrors with low design tolerances, as well as the large amount of piping.

Figure 4. Trough Style CSP, A) Arizona's Solana Generating Station; B) Abu Dhabi

All CSP power plants use tracking technology in order to move the mirrors or reflecting surface with the sun throughout the day and the year. The working fluid may be water, but is more often a heat transfer fluid (HTF) such as a synthetic oil and the thermal energy transferred to a heat exchanger where it turns water to steam to run a turbine. While most steam turbines use water to run the turbine as steam, they also use water to cool/condense the steam to be reused. Many CSP plants are now using dry cooling to condense the steam so as to minimize water usage.

The use of molten salt can be combined in a CSP plant that can also extend the daily power generation period beyond just the sunlight hours. At least two CSP plants were commissioned in the US Southwest in the late 2013, early 2014 time period. Solar Reserve's Crescent Dunes 110 MW plant encompasses 1,500 acres. The tower used to collect the heat at the Crescent Dunes project rises to 650 feet. Bright Source Energy's Ivanpah Project is 377 MW and encompasses 3,500 acres. The tower used to collect the heat at the Ivanpah site rise to 475 feet. Water usage using dry cooling amounts to approximately 0.03 Gal/kWh. Comparatively, water usage for a trough style CSP with wet cooling is around 1 Gal/kWh[4].

Figure 5. A) Ivanpah's Solar Electric Generating Facility (CSP); B) A CPV Tracker by Soitec

[4] *NRELWebsite, Solar Energy Generating Stations in Mojave Desert*

CPV utilizes the traditional photovoltaic (PV) silicon wafer cell technology that has recently become widespread, with a few technical enhancements. The common solar photovoltaic modules use silicon technology that is at a maximum, a little over 20% efficient. CPV uses the same silicon based technology but is much more efficient, up to around 40%. CPV achieves this higher efficiency, because instead of having one semiconductor junction that focuses on collecting only a part of the visible spectrum of light, it has multiple semiconductor junctions that collect multiple parts of the visible light spectrum. Because these CPV condensed wafers, also known as "chips" are more expensive to produce per unit area than normal solar PV wafers, the silicon wafers are cut up into small pieces, arranged in a grid pattern in the solar module. A special optical plastic lens is then used to focus the light on only where the solar PV chip lies. CPV modules still are more expensive to build than the traditional solar PV modules, and manufacturers must install them on dual axis trackers to follow the sun. CPV trackers are typically around 30 feet in height and about 50 feet in width and each tracker is about 25 kW in installed capacity. A CPV array typically produces about 1 MW for every 7 acres of land.

Because optical plastic lenses are used to refract the light onto the CPV chip, direct normal incident (DNI) sunlight is the only light that passes through the lens and onto the chip. In normal PV panels, both direct sunlight and diffused sunlight (light scattered by the atmosphere) can pass through the flat glass and be captured by the photovoltaic wafer. Traditional PV modules may be sited based on the Global Horizontal Irradiance (GHI) a combination of the direct and diffuse light, CPV modules are sited based solely on DNI as are CSP systems since diffuse light plays no role in heating a working fluid, but rather only direct light. Imperial County has a very high resource when it comes to Direct Normal Incident light. This can be due to a combination of environmental factors such as dry weather which decreases the amount of light diffused by particles in the air, the southern latitude, and the lack of cloud cover.

In order to develop an area for solar technology, besides prospecting for the best resource for the best technology (GHI for normal PV, and DNI for CPV/CSP), a good site for solar also has access to transmission capacity in the local electric grid, as well as relatively even terrain for ease of construction. CSP in the form of towers and CPV trackers both could likely make due with more rugged terrain than trough style CSP. Additionally, since CSP ultimately must create steam to run a conventional steam turbine, fresh water must be readily available for make-up and cleaning of the mirror surfaces. Because of advantageous Colorado River water rights, both CSP and CPV are viable technologies and could provide for a significant financial contribution to the Imperial County economy. Neither technologies generate significant noise or emissions except for the back-up generators that may be used onsite for stowing trackers in the case of a grid outage. These can be enclosed in a building or have walls built around them to attenuate the noise. All solar technologies typically create some level of glare which may create issues for the Federal Aviation Administration (FAA). Currently Sandia National Laboratory has a glare model which the FAA has adopted to study the impact to air navigation.