

# **An Interactive Mapping Tool for Burrowing Owl Conservation in Imperial Valley, California**

**2004-2015**



**Prepared for:**

**Imperial Valley Community Foundation  
1440 W. Main St.  
El Centro, California 92243**



**Prepared by:**

**Audubon California  
220 Montgomery St. Suite 1000  
San Francisco, California 94104**



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## 1. Executive Summary

The Imperial Valley in California is home to about 70% of the state's breeding Burrowing Owls (DeSante, Ruhlen, and Scalf 2007). Agriculture has long been present in the region; more recently, solar and geothermal energy development has been on the rise. To address potential conflicts, Audubon California has created an online, interactive map of Burrowing Owls (and their burrows, or nests) observed during the past decade from a variety of surveys, as well as crop types, irrigation canals and drains, renewable energy projects, and more. Audubon then used this rich dataset to explore conservation solutions in this highly altered landscape. For each owl and burrow, Audubon California identified the nearest crop. The average densities of owls and burrows were then calculated within each crop type. Land uses or crops with high densities of owls could be interpreted as excellent candidates for conservation or mitigation lands for this species. These land uses include irrigation canals and drains, particularly earthen ones, as well as crops such as citrus and miscellaneous fruit and vegetables that border the valley along the northeastern and southeastern edges. Land uses or crops with low densities of owls may have the least conflict with new development and could be interpreted as options to explore further for the sighting of alternative land uses. These include fallow and idle cropland, barren land, and open water, among others. The shoreline of the Salton Sea, which borders the valley to the north, is expected to recede dramatically in the near-term; exposed lakebed will be barren and could also be a prime option to explore for the sighting of alternative land uses. The interactive map and the data therein are publicly available to enable other researchers to study additional research questions related to the Burrowing Owl in Imperial Valley. This work was made possible by the Imperial Valley Community Foundation.

## 2. Introduction

Approximately 70% of California’s Burrowing Owl breeding population occurs in Imperial Valley (DeSante, Ruhlen, and Scalf 2007). Most occur on private lands and are at times in conflict with farming activities or proposed development, particularly renewable energy projects. Because the species is a California Bird Species of Special Concern (California Department of Fish and Wildlife, Point Blue, and Western Field Ornithologists 2008), mitigation measures and conservation actions must be applied where there are potential impacts from development projects on breeding and foraging sites. In addition to state protections as a California Species of Special Concern, the Burrowing Owl is a U.S. Fish and Wildlife Service (USFWS) Bird of Conservation Concern (U.S. Fish and Wildlife Service 2008) and a Bureau of Land Management (BLM) Sensitive Species (BLM 2010). The Burrowing Owl is also a focal species for Audubon California.

The Burrowing Owl population in Imperial Valley is dramatically lower than in the early 1990s (Table 1). Factors contributing to this rapid decline include “rapid loss of farmland, changes in agricultural practices, eradication of ground squirrels, pesticide use, traffic and wind turbine-related mortality, and possibly West Nile virus” (Gervais, Rosenberg, and Comrack 2008).

In response to changes in Burrowing Owl populations in Imperial Valley and increasing solar and geothermal development in potential Burrowing Owl habitat in the region, Audubon California has created a publicly available, interactive map that consolidates Burrowing Owl survey data from the past decade (2004-2015) in Imperial Valley. We have created this map as a framework to prioritize Burrowing Owl conservation and mitigation sites, both on public and private lands.

**Table 1 – Burrowing Owl Populations in Imperial Valley**

<b>Survey Year(s)</b>	<b>Imperial Valley Population Estimate (pairs)</b>	<b>Source</b>
<b>1991-1993</b>	6,571	(DeSante, Ruhlen, and Scalf 2007)
<b>1992-1993</b>	5,600 (3,405-7,795)	(DeSante, Ruhlen, and Rosenberg 2004)
<b>2006-2007</b>	6,408 ± 2,384	(Wilkerson and Siegel 2010)
<b>2007</b>	4,879	(Manning 2009)
<b>2008</b>	3,557	(Manning 2009)
<b>2011</b>	4,589-5,058	(AECOM 2012)
<b>2012</b>	3,776-4,133	(AECOM 2012)

### 3. Acronym List

Acronyms used in this report and related materials are defined below.

BBS	Breeding Bird Survey
BLM	Bureau of Land Management
BUOW	Burrowing Owl
CBI	Conservation Biology Institute
CEC	California Energy Commission
CNDDDB	California Natural Diversity Database
CPAD	California Protected Areas Database
DOE	U.S. Department of Energy
DRECP	Desert Renewable Energy Conservation Plan
GIS	Geographic Information System
IBA	Important Bird Area
IBP	Institute for Bird Populations
IID	Imperial Irrigation District
MW	Megawatt
NWR	National Wildlife Refuge
ROW	Right-of-Way
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish & Wildlife Service
USGS	U.S. Geological Survey

## 4. Map Preparation

Audubon California used Esri's ArcGIS Online to create this map, and all layers have been shared publicly via the platform. ArcGIS Online is an online Geographic Information System (GIS) platform for using and sharing geospatial data and tools. Users have the ability to turn on and off layers in order to view the combination of layers that best helps answer questions of interest. The layers are available for download, with instructions included on the website.

### a. Data Acquisition

We consulted with local and other stakeholders to 1) understand what type of map and database would best serve their goals, 2) obtain datasets, and 3) seek their input on a draft map. Identified stakeholders with whom we engaged are listed below.

#### *Government Agencies:*

- Bureau of Land Management (BLM)
- California Department of Fish & Wildlife (CDFW)
- California Energy Commission (CEC)
- U.S. Department of Agriculture (USDA) Forest Service
- U.S. Fish & Wildlife Service (USFWS)
- U.S. Geological Survey (USGS)
- Sonny Bono Salton Sea National Wildlife Refuge (NWR)
- California Natural Diversity Database (CNDDDB)

#### *Consulting Firms:*

- AECOM
- Albion Environmental
- Barrett's Biological Surveys
- Bloom Biological
- Manning Biological

#### *Burrowing Owl Academic Researchers:*

- Boise State University
- San Jose State University
- University of Alberta

#### *Conservation and Research Organizations:*

- Burrowing Owl Conservation Network
- Burrowing Owl Preservation Society
- Center for Biological Diversity
- Defenders of Wildlife

- Global Owl Project
- Institute for Bird Populations (IBP)
- Oregon Wildlife Institute
- Researchers Implementing Conservation Action
- Ronan & Gregory
- Riverside Land Conservancy
- San Bernardino Valley Audubon Society
- San Diego Audubon Society
- San Diego Zoo
- Sierra Club

*Local Stakeholders and Farmers:*

- Imperial Irrigation District (IID)
- Imperial County Agricultural Commissioner’s Office
- Imperial County Assessor’s Office
- Imperial County Farm Bureau
- Imperial County Planning & Development Services
- Imperial Valley Community Foundation
- Imperial Valley Vegetable Growers Association

Through this process, Audubon California obtained relevant data layers. Data was generously shared by the IID, IBP, the Sonny Bono Salton Sea NWR, eBird, the CNDDDB, and Imperial County Assessor’s Office. The map also includes publicly available datasets from the USGS, USDA, CEC, BLM, the California Protected Areas Database (CPAD), the Desert Renewable Energy Conservation Plan (DRECP), the California Department of Conservation, and Esri. See Table A-1 in Appendix A for more details including citations.

**b. Initial Stakeholder Suggestions**

Audubon reached out to 66 individual stakeholders for initial feedback regarding the map development. Stakeholders are described in the previous section and include federal and state agencies, consulting firms, academic researchers, conservation and research organizations, and local agencies and farmers.

Stakeholders were asked to fill out a [brief online survey](#), in which they were asked to describe the kinds of questions they want to use this map to answer, indicate which data layers were useful to them, suggest any additional layers of interest, describe about any data layers they possessed and could share, provide any other suggestions, indicate their interest in reviewing a draft map, and describe what kind of organization(s) they work with (consulting firm, government agency, etc.). Sixteen of the sixty-six stakeholders provided feedback via the initial online survey.

Based on the feedback we received, we made several improvements to the map. We added layers to identify areas where Burrowing Owls have not been surveyed, where that information is available (i.e.,

all IID surveys except the Pilot Study in 2006, and the IBP surveys). For the BBS records, the survey routes are shown. Lastly, for the Sonny Bono Salton Sea NWR artificial nest box surveys, the locations of the surveyed nest boxes are shown. Only the CNDDDB records do not have any information about areas not surveyed. Based on feedback received, we also designed the map to differentiate between earthen and concrete drains and canals in the IID network. Lastly, we included known artificial burrows located within the Sonny Bono Salton Sea NWR, along with all available attributes.

We ultimately opted to exclude a few suggested layers, shown in Table A-3 of Appendix A. The reasons for their exclusion are also included in the appendix.

### **c. Draft Map Review by Stakeholders**

After completing a draft map, Audubon reached out to stakeholders who had volunteered to review the draft map to inquire if the map contained the kinds of information that is helpful for them, and provide general feedback.

We received feedback on the draft map from six stakeholders. Feedback was positive, and a few additional suggestions were raised. Based on this feedback, we added a layer showing important farmland. We also attempted to obtain geospatial data from the recent Imperial County Renewable Energy and Transmission Element but were unable to acquire it. We changed renewable energy project locations from points to footprints, where geospatial data on project footprints were available. We obtained footprints for solar power plants from the Imperial County Assessor's Office; they do not keep footprints for geothermal power plants, which tend to have small footprints. Lastly, we made a few minor editorial updates based on feedback received from IID.

### **d. Final Map**

The final map is available on Audubon California's website: <http://ca.audubon.org/salton-sea>, in addition to other sites described in the **Accessibility** section below. The layers in the final map are described in Table A-1 in the Appendix.

### **e. Metadata**

Table A-2 in the Appendix indicates both the data provider (source) and a link to the comprehensive metadata for each layer in the map.



## 5. Methods and Analysis

Audubon performed analyses using data from the map to study questions of interest about Burrowing Owls in Imperial Valley. In particular, we investigated habitat associations with the goals of informing alternative land use project siting and informing mitigation efforts.

### a. Habitat Association

We first sought to better understand the association between owl occurrence and specific land uses and habitats. We based these analyses on the IID and IBP surveys, which are point-based. We designed a geospatial model developed using Esri's ArcMap software to perform these analyses.

The IID surveys include the number of owls observed, as well as burrow observations. They covered years 2006 (a pilot study), 2007-2008 (valley-wide on IID Rights-of-Way), and 2011-2012 (limited to certain areas within the valley on IID Rights-of-Way). During the three different IID survey periods (2006, 2007-2008, and 2011-2012), survey methodologies varied, but all include records of owl and burrow observations. The 2006 survey was a pilot study limited to a small area within the valley and was conducted from April 16 to May 20, 2006. The 2007-2008 surveys were meant to be a complete valley-wide census. They were conducted using 274 standardized 3-kilometer (km) by 3-km blocks and were conducted from April 2 to May 3, 2007 and from March 28 to April 30, 2008. The 2011-2012 surveys were limited to 55 of the 3-km by 3-km blocks to track changes in population over time and were conducted between May 10 and May 20, 2011 and between March 26 and April 27, 2012.

The IBP surveys covered years 2006 and 2007 and were limited to certain 5-km by 5-km blocks within the valley. Surveys were conducted between May 1 and July 1 both years. For each detection location, a count of all owls seen, an estimate of the number of breeding pairs present, and standardized habitat information was recorded.

First, for each (individual) Burrowing Owl observed during the IID and IBP surveys, we identified the closest land use or crop based on remote sensing estimates of crop types (United States Department of Agriculture 2014). We then summed the number of owls associated with each type of crop by year.

Next, we performed a variation on this analysis. Instead of summing the number of owls associated with each crop type by year, we summed the number of owl observations associated with each crop type by year. This variation is therefore not dependent on whether one owl or a pair (or more owls) were present at a given location. This analysis was based on both IID and IBP survey results.

Lastly, we performed a similar analysis but counted the number of burrows associated with each crop type by year. This analysis was based on only the IID survey results.

For all three analyses described above, we present the actual counts described above (Tables 2a, 3a, and 4a, described below), as well as the counts divided (normalized) by the area of each crop surveyed in that year to estimate an average density in each crop type during each survey (Tables 2b, 3b, and 4b, described below).

#### **b. Inform Alternative Land Use Project Siting**

Based on the results of this analysis, we determined land uses that are of relatively low importance to Burrowing Owls (i.e., a combination of low owl densities, low densities of owl observations, and/or low burrow densities). We consider these land uses as areas of least conflict with Burrowing Owls; they may be considered as potential options for siting alternative land use projects. However, it is important to note that we have not analyzed these areas for other species of concern that forage or roost in agriculture, such as Mountain Plover, White-faced Ibis, Long-billed Curlew, and others (Audubon California 2009). We recommend such an analysis be undertaken before projects are sited in these areas.

We first ranked the results for each survey shown in Tables 2b, 3b, and 4b. We divided the rank of each crop by the total number of crops for each survey to get a normalized rank (varying between 0 and 1, where 0 is the crop type with the highest density, and 1 is the crop type with the lowest density). We then averaged these normalized rankings across all surveys for each land use, and termed land uses with the highest average normalized rank as being of low importance to owls. We determined the five land uses of lowest importance to owls in terms of A) owl density, B) owl observation density, and C) burrow density.

Surveyed area is not available for the IID pilot study survey in 2006. Additionally, although crop data for 2006 was available from IID, crop data for 2007 onward is from USDA; to prevent any differences in methodologies used to create these two datasets from impacting our conclusions, and because of a lack of information on the area surveyed by IID that year, we have excluded both 2006 surveys from Tables 2b, 3b, and 4b.

#### **c. Inform Mitigation Efforts**

It is also helpful to understand what land uses and crop types are of particular importance to Burrowing Owls. These areas may be potential future conservation areas or mitigation lands for the species.

We used the methods described in Section 4b but instead determined the five land uses of greatest importance to owls in terms of A) owl density, B) owl observation density, and C) burrow density. Thus, these are the lands with the lowest average normalized rank.

## 6. Results

### a. Habitat Association

The results of the habitat association analyses are summarized in Tables 2a-4b.

Table 2a shows the sum of observed owls within each surveyed crop type in which owls were observed. Excluding the developed/low intensity and shrubland land uses, more owls were observed in alfalfa than any other crop in all years and surveys shown. Summing across all years, more owls were observed in or near alfalfa than any other land use.

In Tables 2a-4b, land uses that are not crops are grayed out. Horizontal blue bars visually denote the relative quantities (Tables 2a, 3a, and 4a) or densities (Tables 2b, 3b, and 4b) of owls, owl observations, and burrows associated with each crop within a specific survey (that is, column).

*Table 2a – Sum of Observed Owls by Crop Type*

Land Use/Crop Type	IID 2006	IBP 2006	IID 2007	IBP 2007	IID 2008	IID 2011	IID 2012
Alfalfa	1684	101	4672	75	3604	80	164
Barren	144	5	24	3	60	1	7
Broccoli						1	1
Cantaloupes	97	3			29		4
Carrots	8	1	6			2	23
Citrus						5	19
Developed/Low Intensity			4793	99	4140	86	310
Developed/Med Intensity			87		115	5	23
Developed/Open Space			1232	12	727	23	74
Durum Wheat	522	17	1440	30	1173	16	142
Fallow/Idle Cropland	110	17	577	7	2281	33	51
Greens							4
Herbs			12		5		1
Lettuce	8				7		8
Misc Veggies & Fruits	39	2				5	6
Onions	135	13			18	3	6
Other Hay/Non Alfalfa			61			30	78
Rye							
Shrubland			5039	50	1705	129	298
Sugarbeets	220	45	10		9	9	17
Sweet Corn						2	2

Table 2b presents the results of Table 2a, normalized by the area of each crop surveyed (square miles). In all surveys, owl densities were higher in the developed/open space, developed/low intensity, or shrubland categories than any other land use type; however, in recent years (2011-2012), this trend is much less pronounced than in earlier IID surveys (2007 and 2008).

In the most recent survey (IID 2012), among crops, owls were observed in highest densities in citrus crops (20.3 owls per square mile), followed closely by herbs (18.2 owls per square mile). In the 2011 IID survey, owls densities in crops were highest in the miscellaneous vegetables and fruits category (7.2 owls per square mile), followed by citrus (5.5 owls per square mile).

**Table 2b – Density of Observed Owls by Crop Type (owls per square mile surveyed)**

Land Use/Crop Type	IID 2006	IBP 2006	IID 2007	IBP 2007	IID 2008	IID 2011	IID 2012
Alfalfa			16.7	1.7	15.1	1.7	3.3
Barren			1.7	1.2	5.4	0.45	2.6
Broccoli						1.9	1
Cantaloupes					15.2		3.7
Carrots			8.9			0.7	6
Citrus						5.5	20.3
Developed/Low Intensity			86.5	13.3	82.6	7.4	26.7
Developed/Med Intensity			7		8.9	1.5	6.4
Developed/Open Space			85.2	6.1	79.3	12.5	27.9
Durum Wheat			14.9	2	10.4	0.7	4.4
Fallow/Idle Cropland			12	1.2	13.7	1.8	4.9
Greens							3
Herbs			7.1		24.9		18.2
Lettuce					2.4		2.8
Misc Veggies & Fruits						7.2	5.6
Onions					6.2	1.1	1.7
Other Hay/Non Alfalfa			6.2			1.1	3.7
Rye							
Shrubland			28.6	1.4	39.2	7.7	14.7
Sugarbeets			12.6		1.2	0.8	1.4
Sweet Corn						1.5	6.1

Table 3a shows the count of owl observations within each surveyed crop type in which owls were observed. Excluding the developed/low intensity and shrubland land uses, more owl observations were documented in alfalfa than any other crop in all years and surveys shown. Summing across all years, more owl observations were made in or near alfalfa than any other crop.

**Table 3a – Count of Owl Observations by Crop Type**

Land Use/Crop Type	IID 2006	IBP 2006	IID 2007	IBP 2007	IID 2008	IID 2011	IID 2012
Alfalfa	1373	66	3359	51	2631	68	107
Barren	111	5	18	3	37	1	4
Broccoli						1	1
Cantaloupes	83	2			18		2
Carrots	7	1	5			2	14
Citrus						4	11
Developed/Low Intensity			3410	65	2998	76	199
Developed/Med Intensity			70		83	4	15
Developed/Open Space			865	10	528	18	50
Durum Wheat	435	13	1005	19	813	15	89
Fallow/Idle Cropland	84	12	445	5	1673	29	38
Greens							2
Herbs			11		3		1
Lettuce	7				7		6
Misc Veggies & Fruits	34	2				3	4
Onions	115	10			13	2	4
Other Hay/Non Alfalfa			44			27	50
Rye							
Shrubland			3684	39	1267	112	202
Sugarbeets	181	32	6		7	9	10
Sweet Corn						2	1

Table 3b presents the results of Table 3a, normalized by the area of each crop surveyed (square miles). With the exception of the IBP 2007 survey, owl observation densities were higher in the developed/open space, developed/low intensity, or shrubland categories than any other land use type; however, as with Table 2b, in recent years (2011-2012), this trend is much less pronounced than in earlier IID surveys (2007 and 2008).

In the most recent survey (IID 2012), among crops, densities of owl observations were highest in citrus crops (18.2 owl observations per square mile), followed closely by herbs (11.8 owl observations per square mile). In the 2011 IID survey, densities of owl observations in crops were highest in citrus (4.4 owl observations per square mile), followed by the miscellaneous vegetables and fruits category (4.3 owl observations per square mile).

**Table 3b – Density of Owl Observations by Crop Type (owl observations per square mile surveyed)**

Land Use/Crop Type	IID 2006	IBP 2006	IID 2007	IBP 2007	IID 2008	IID 2011	IID 2012
Alfalfa			12	1.2	11	1.4	2.1
Barren			1.3	1.2	3.3	0.5	1.5
Broccoli						1.9	1
Cantaloupes					9.4		1.9
Carrots			7.4			0.7	3.7
Citrus						4.4	11.8
Developed/Low Intensity			61.5	8.8	59.8	6.5	17.1
Developed/Med Intensity			5.7		6.4	1.2	4.2
Developed/Open Space			59.8	5.1	57.6	9.8	18.8
Durum Wheat			10.4	1.3	7.2	0.7	2.8
Fallow/Idle Cropland			9.3	0.9	10	1.5	3.7
Greens							1.5
Herbs			6.5		14.9		18.2
Lettuce					2.4		2.1
Misc Veggies & Fruits						4.3	3.7
Onions					4.5	0.7	1.1
Other Hay/Non Alfalfa			4.4			1	2.4
Rye							
Shrubland			20.9	1.1	29.2	6.7	10
Sugarbeets			7.6		1	0.8	0.8
Sweet Corn						1.5	3

Table 4a shows the sum of burrows within each surveyed crop type in which owls were observed. Excluding the developed/low intensity and shrubland land uses, more owl observations were documented in alfalfa than any other crop in all years and surveys shown, with the exception of the IID pilot survey in 2006, in which case the more burrows were found in grass/pasture than any other land use, followed by alfalfa. Summing across all years, more burrows were observed in or near alfalfa than any other crop.

**Table 4a – Sum of Burrows by Crop Type**

Land Use/Crop Type	IID 2006	IID 2007	IID 2008	IID 2011	IID 2012
Alfalfa	1157	2823	2005	121	100
Barren	82	15	25		4
Broccoli				1	1
Cantaloupes	78		18	3	2
Carrots	4	5		4	12
Citrus				5	11
Developed/Low Intensity		2969	2368	161	176
Developed/Med Intensity		54	70	11	15
Developed/Open Space		729	427	29	46
Durum Wheat	363	885	662	29	77
Fallow/Idle Cropland	69	371	1365	34	35
Greens				1	2
Herbs		11	3	1	1
Lettuce	6		5		4
Misc Veggies & Fruits	24			2	4
Onions	107		9	4	3
Other Hay/Non Alfalfa		33		47	46
Rye				2	1
Shrubland		3099	996	147	180
Sugarbeets	159	7	6	14	8
Sweet Corn				1	1
Cotton				2	
DbI Crop Lettuce/Durum Wht			8	3	
Almonds				1	
Open Water		3	3	2	
Developed/High Intensity			6	2	
Oats	22	14	11		
Grass/Pasture	1227	1397	1800		
Other Small Grains			488		
Oranges			105		
Other Tree Crops			51		
Corn	119	5	14		2
Other Crops	17		7		
Asparagus	10		4		
Sorghum		9			
Barley		4			
Sugarcane		1			
Canola		1			
Sod/Grass Seed		1			
Cauliflower	9				
Cucumbers					1

Table 4b presents the results of Table 4a, normalized by the area of each crop surveyed (square miles). In the IID surveys in 2007 and 2008, burrow densities were greatest in or near developed/low intensity and developed/open space, followed by sorghum and shrubland in 2007 and shrubland and oats in 2008. Conversely, in the IID surveys in 2011 and 2012, burrow densities were greatest in Rye (26.4 and 29.8 burrows per square mile, respectively).

In the most recent surveys (IID 2011 and 2012), among crops, burrow densities were highest in rye (29.8 and 26.4 burrows per square mile, respectively), followed by cucumbers in 2012 (25 burrows per square mile) and herbs both years (15.8 and 18.2 burrows per square mile, respectively).



**Table 4b – Density of Burrows by Crop Type (burrows per square mile surveyed)**

Land Use/Crop Type	IID 2006	IID 2007	IID 2008	IID 2011	IID 2012
Alfalfa		10.1	8.4	2.5	2
Barren		1	2.3		1.5
Broccoli				1.9	1
Cantaloupes			9.4	1.4	1.9
Carrots		7.4		1.5	3.1
Citrus				5.5	11.8
Developed/Low Intensity		53.6	47.2	13.8	15.1
Developed/Med Intensity		4.4	5.4	3.2	4.2
Developed/Open Space		50.4	46.6	15.8	17.3
Durum Wheat		9.1	5.9	1.3	2.4
Fallow/Idle Cropland		7.7	8.2	1.8	3.4
Greens				0.9	1.5
Herbs		6.5	14.9	15.8	18.2
Lettuce			1.7		1.4
Misc Veggies & Fruits				2.9	3.7
Onions			3.1	1.5	0.9
Other Hay/Non Alfalfa		3.3		1.7	2.2
Rye				29.8	26.4
Shrubland		17.6	22.9	8.8	8.9
Sugarbeets		8.8	0.8	1.2	0.7
Sweet Corn				0.7	3
Cotton				2.2	
DbI Crop Lettuce/Durum Wht			4.6	1.7	
Almonds				8.5	
Open Water		0.4	0.5	1.2	
Developed/High Intensity			2.8	5.6	
Oats		4.4	18.5		
Grass/Pasture		8.4	13.8		
Other Small Grains			7.1		
Oranges			8.1		
Other Tree Crops			13.8		
Corn		2	4.6		3.7
Other Crops			2.2		
Asparagus			5.5		
Sorghum		30.8			
Barley		9.3			
Sugarcane		5.9			
Canola		1.5			
Sod/Grass Seed		1.4			
Cauliflower					
Cucumbers					25

**b. Inform Alternative Land Use Project Siting**

Based on the results of Table 2b and the methods described in Section 4b, we conclude that the following land uses are of relatively low importance to owls in terms of owl density:

- Barren
- Sugarbeets
- Durum Wheat
- Onions
- Fallow/Idle Cropland

In terms of the density of owl observations (Table 3b), the following land uses are of relatively low importance:

- Barren
- Sugarbeets
- Durum Wheat
- Fallow/Idle Cropland
- Alfalfa

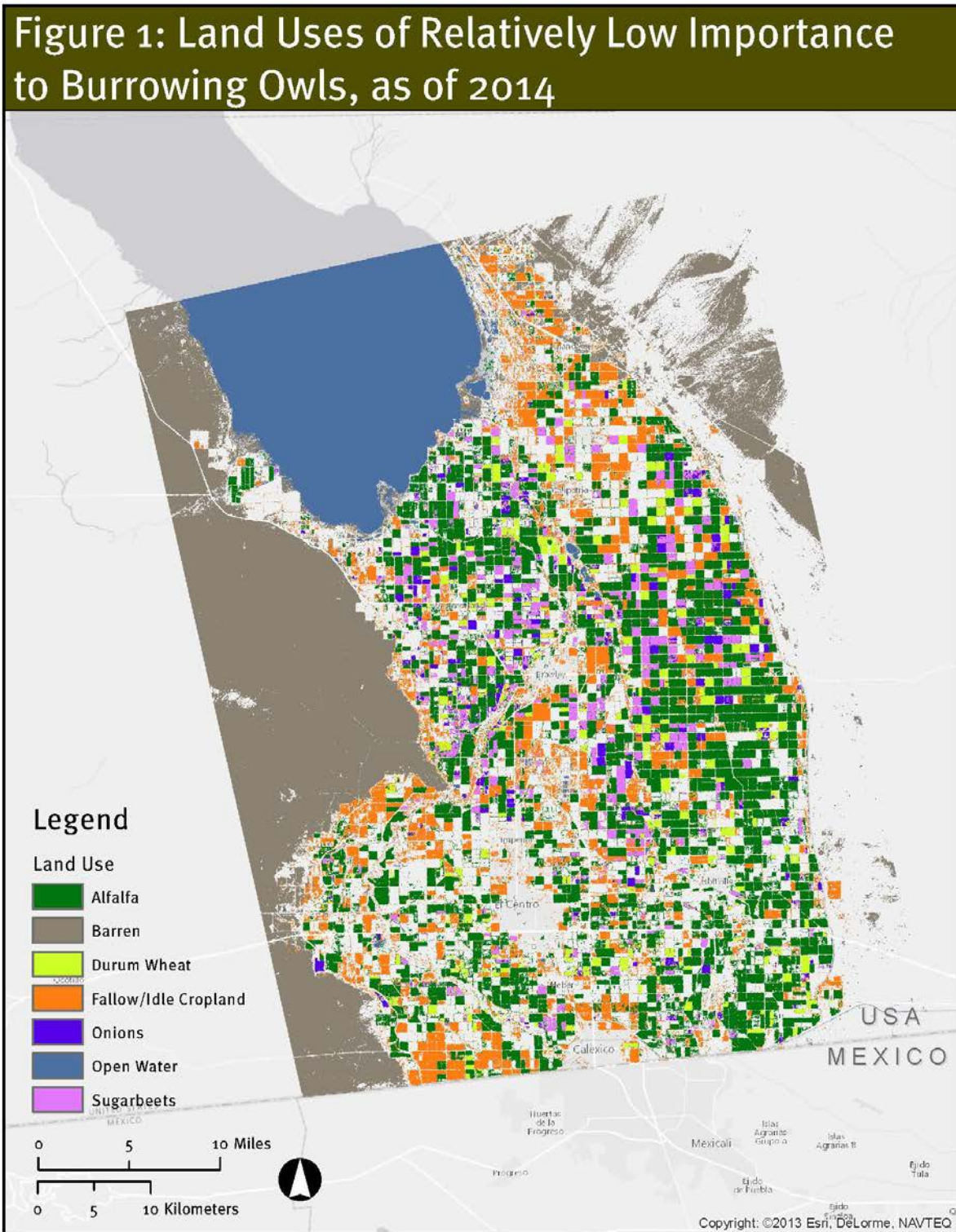
Finally, in terms of burrow density (Table 4b), the following land uses are of relatively low importance:

- Sugarbeets
- Open Water
- Barren
- Durum Wheat
- Onions

Of course, as is evident from Tables 2a, 3a, and 4a, some of these land uses (e.g., alfalfa) occur across large swaths of Imperial Valley, and, as such, host large numbers of owls despite having low densities of owls.

Using USDA's most recent Cropland layer (2014), Figure 1 shows where the land uses described in this section occur throughout Imperial Valley. These land uses were found to support the lowest densities of owls, owl observations, and burrows. These areas can be interpreted as areas of least conflict with Burrowing Owls. There may be other land uses with lower absolute numbers of owls, owl observations, and burrows due to smaller absolute areas. Alfalfa in particular is present across large swaths of the valley; therefore, despite low densities of owl observations therein, alfalfa hosts high absolute numbers of owls and burrows compared with other land uses.

Figure 1 – Land Uses of Relatively Low Importance to Burrowing Owls in Imperial Valley, as of 2014



### c. Inform Mitigation Efforts

Based on the results of Table 2b and the methods described in Section 4b, we conclude that the following land uses are of relatively high importance to owls in terms of owl density:

- Rye
- Developed/Low Intensity
- Citrus
- Developed/Open Space
- Misc Veggies & Fruits

In terms of the density of owl observations (Table 3b), the following land uses are of relatively high importance:

- Rye
- Citrus
- Developed/Open Space
- Developed/Low Intensity
- Misc Veggies & Fruits

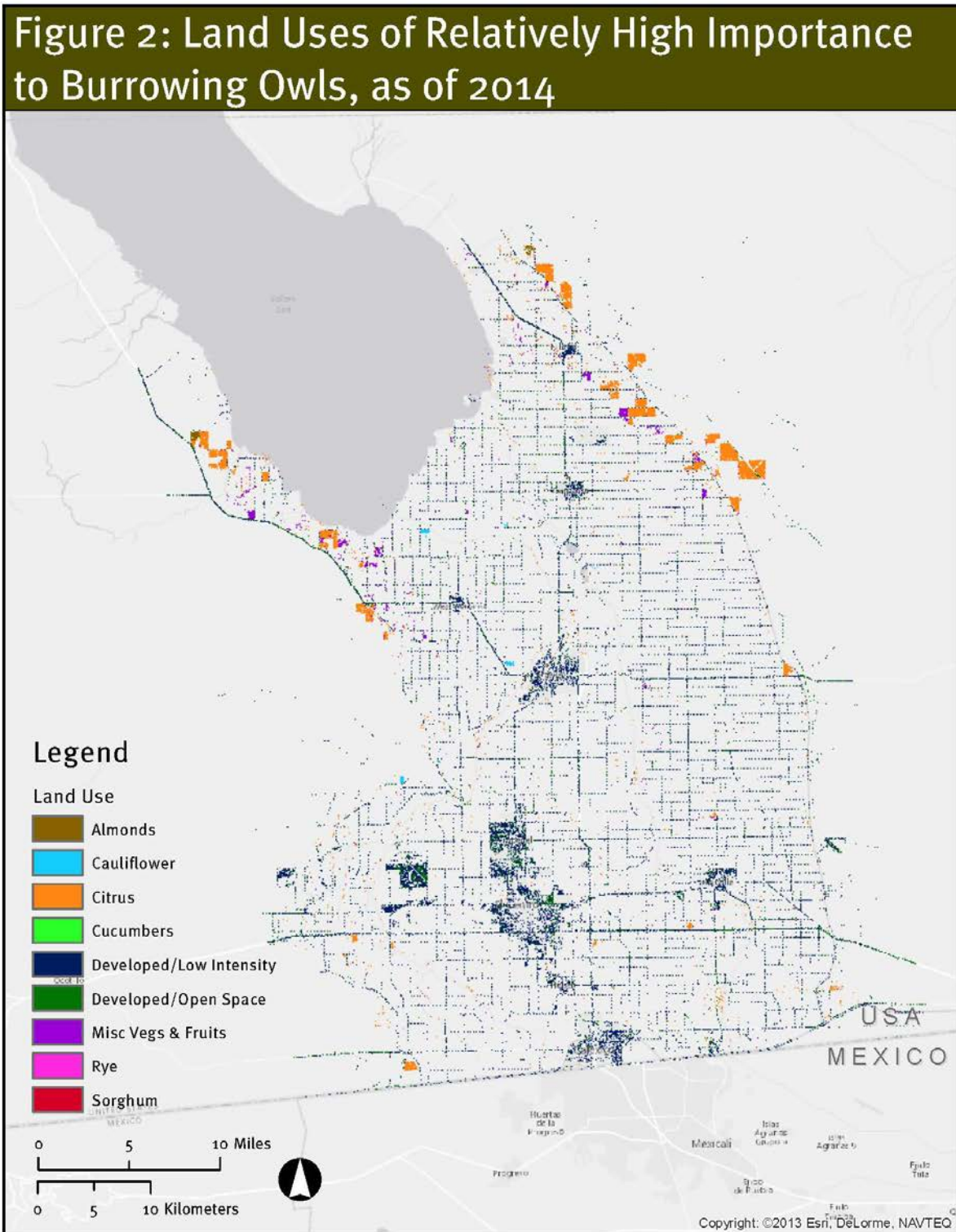
Finally, in terms of burrow density (Table 4b), the following land uses are of relatively high importance:

- Cauliflower
- Cucumbers
- Rye
- Almonds
- Sorghum

It is important to be aware that these are the land uses that generally host high densities of Burrowing Owls or burrows; they are not necessarily present in Imperial Valley in large areas.

Using USDA's most recent Cropland layer (2014), Figure 2 shows where these land uses occur throughout Imperial Valley. These land uses were found to support the highest densities of owls, owl observations, and burrows. These lands can be interpreted as potential conservation or mitigation lands. There may be other land uses with higher absolute numbers of owls, owl observations, and burrows due to larger absolute areas.

Figure 2 – Land Uses of Relatively High Importance to Burrowing Owls in Imperial Valley, as of 2014



## 7. Discussion

### a. Alternative land use siting

Areas with relatively low densities of Burrowing Owls and/or burrows can be viewed as potential opportunities for siting alternative land uses like renewable energy. Although alfalfa has high absolute numbers of Burrowing Owls, due in part to its large footprint in the Imperial Valley, it actually is associated with relatively low densities of owls compared with other land uses in the region. Thus, alfalfa fields may be an attractive option for siting alternative land uses. However, it is important to note that about 80% of Burrowing Owl foraging occurs within about 1,950 feet of the nest burrows (DRECP 2014); this foraging distance should be considered when siting alternative land uses, taking care to be set back from known burrows and/or crop types with high densities of burrows (Table 4b, Figure 2). To account for foraging activities, we recommend referring to the California Department of Fish and Wildlife's recommended setback distances from known burrows (California Department of Fish and Game 2012); all known burrows from the past decade are available for download from the online map (download instructions available on the website). It is also important to note that alfalfa is an important crop for other bird species in California (Audubon California 2009), and the impacts to all biological endpoints, such as Mountain Plover, White-faced Ibis, Long-billed Curlew, and others (Audubon California 2009), should be assessed when siting an alternative land use.

More desirable options for siting alternative land uses might be barren lands and/or fallow/idle cropland, both of which are, perhaps not surprisingly, associated with relatively low densities of owls.

It is not surprising that open water supports low densities of owls, but it is important to keep in mind that the Salton Sea shoreline is expected to recede dramatically in near future as a result of planned changes to water deliveries (Cohen 2014). The land exposed by the receding Sea will presumably be barren land initially, and thus represents a promising opportunity for siting alternative land uses. Co-benefits would include keeping dust levels down in this area that already experiences high concentrations of airborne particulates and all of the associated health impacts (Cohen 2014).

### b. Conservation and mitigation lands siting

Areas with relatively high densities of Burrowing Owls and/or burrows can be viewed as potential opportunities for setting aside conservation or mitigation lands. These land uses already support high densities of owls and burrows, and their protection may be key to the species' survival in the area.

Though it may seem surprising on first look that the developed/low intensity land use falls into this category, on closer look it generally overlaps with IID's canal and drain network. Earlier work by IID demonstrated that Burrowing Owls nest almost exclusively within or along irrigation drains, canals, and ditches, particularly earthen drains. As IID concluded, "this is not surprising... as earthen banks appear to provide more suitable nesting habitat." There may also have been more earthen drains sampled in IID's surveys, possibly skewing the results (AECOM 2012). Thus, these particular land uses (i.e., drains and canals) are likely what is driving the high densities of owls observed in the broader developed/low intensity land use category. The results of this analysis, along with IID's findings, suggest that the

conversion of concrete canals and drains to an earthen construction could help provide additional nesting habitat in the region, and that maintenance of existing earthen drains and canals is likely an important element in preventing further declines of owls in the region.

Citrus lands appear to represent another prime opportunity for conservation and mitigation lands, based on existing high densities of owls and burrows therein, and the relatively large, intact parcels available.

It is useful to note that projects sited on Prime Farmland or Farmlands of Statewide Importance, depicted in the map layer “Imperial County Important Farmland (2012)”, are required to provide mitigation through the siting of agricultural easements elsewhere. It may be more efficient and effective from a conservation perspective to combine such mitigation with any Burrowing Owl conservation and mitigation lands and requirements.

## **8. Data Gaps and Limitations**

It is important for users to be aware of limitations of the map and data therein.

### **a. Areas not surveyed**

The map shows only those observations from the surveys included therein; they are not complete over the state and were performed within the last decade. There may be areas that have not been surveyed where owls are present; these areas should not be interpreted as low priority. Rather, they are areas that would benefit from further research.

The map includes a layer called “Areas Surveyed in IID Surveys” that shows the extent of the Imperial Irrigation District Right-of-Way surveys taking place in 2007, 2008, 2011, and 2012. Similarly, the areas surveyed by the Institute for Bird Populations (IBP) are shown in the layer “Areas Surveyed in IBP Surveys”. We strongly recommend turning on these layers when looking at IID or IBP survey data. The Salton Sea National Wildlife Refuge artificial nest box surveys were limited to the nest box locations; similarly, Breeding Bird Survey (BBS) observations were limited to BBS routes. The survey extent associated with the California Natural Diversity Database (CNDDDB) observations is not known.

### **b. Non-uniform survey methodologies**

Survey methodologies differ between data sources. Some surveys (IID and IBP, for example) are point-based, while others (BBS) are route-based. Furthermore, some surveys report owl abundance, while others document occurrence only. Lastly, effort was not consistently documented across all surveys. As such, users of the data should be aware of the potential hazards of comparing results between various surveys.

### **c. Crops rotating more often than annually, and/or parcels split into multiple crops**

Staff at IID expressed concern that displaying annual crop layers in the map may be misleading, as some landowners may rotate crops more frequently than annually. In these cases, there is a chance that the

crops displayed for a given year may not have been planted coincidental with Burrowing Owl observations. Several of the surveys include surveyor observations of adjacent crop types, which should in such cases be a more reliable source of information.

An additional concern raised by staff at IID is that in some instances parcels may be divided into sub-parcels planted with different crops. The USDA Cropland data layer is generated using satellite imagery and has a ground resolution of 30 meters. Thus, any sub-parcels that are smaller than 30 meters by 30 minutes would not be captured in this dataset.

**d. Geothermal power plant footprints**

The Imperial County Assessor's Office generously provided the point locations of geothermal power plants (as well as solar energy project footprints). The map would be improved through the inclusion of the footprints of geothermal power plants. As of the time of this writing, the Imperial County Assessor's Office does not collect footprint information for geothermal power plants. According to the U.S. Department of Energy (DOE), a typical geothermal field uses 1-8 acres per megawatt (MW), and the environmental impact upon the land they use is minimal (U.S. Department of Energy: Office of Energy Efficiency and Renewable Energy 2015).

**e. Land ownership**

Land ownership could be a useful layer to incorporate as a future improvement to this map. Concerns about privacy and map loading speed led us to omit this information. In lieu of this layer, the Protected Areas (CPAD) layer shows areas owned by public agencies.



## 9. Accessibility

The final map is available on Audubon California's website: <http://ca.audubon.org/salton-sea>. It will also be shared through *The Burrow*, an online resource for Burrowing Owl information and education being created by Noelle Ronan and Chris Gregory through the support of the Imperial Valley Community Foundation.

To increase visibility, the datasets have been made available through the DRECP Gateway on Data Basin, a science-based mapping and analysis platform developed by the Conservation Biology Institute (CBI) that supports learning, research, and sustainable environmental stewardships ([www.databasin.org](http://www.databasin.org)). Data Basin is used for coordinated conservation planning efforts, such as the DRECP.

Finally, we will encourage U.S. Fish & Wildlife Service, California Department of Fish & Wildlife and DRECP to post this map or a link to it on their websites and in all their data sharing efforts such as California Department of Fish and Wildlife's Biogeographic Information and Observation System (BIOS: <http://www.dfg.ca.gov/biogeodata/bios/>).

## **10. Related Conservation Efforts by Audubon California**

Audubon California has been engaged in conservation efforts in the Imperial Valley and nearby Salton Sea for more than 15 years. Both the Imperial Valley and the Salton Sea are globally significant Important Bird Areas (IBAs). The Salton Sea has been selected as a priority IBA for the National Audubon Society, and has been named by BirdLife International as an “IBA in Danger” (<http://www.birdlife.org/datazone/info/ibaidites#USA>).

In early 2015, Audubon California submitted a comment letter on the draft DRECP and EIR/EIS, which will cover renewable energy and conservation planning in the Salton Sea and Imperial Valley. This letter addressed concerns around the treatment of Burrowing Owl in the DRECP plan and directly benefited from this map. The draft DRECP and EIR/EIS was missing a large number of known occurrences of Burrowing Owls in the Imperial Borrego Valley Ecoregion Subarea. Our comment letter addressed the inadequacy of their dataset and pointed the authors to this new online map.

Audubon California is stepping up its engagement at the Salton Sea, immediately adjacent to the Imperial Valley. Our role in helping to address the immense challenges at the Salton Sea includes 1) comprehensive bird data collection, 2) detailed habitat mapping, 3) public education, and 4) policy advocacy. More information can be found on our website: <http://ca.audubon.org/salton-sea>.

## 11. Looking Forward

This work will enable research that will be the scientific basis for other phases of a multi-faceted program to conserve Burrowing Owl and to inform mitigation for Burrowing Owl in Imperial Valley.

If additional funding is secured for Audubon to lead a Burrowing Owl conservation program, Audubon will continue to attempt to acquire geospatial layers that will help information Burrowing Owl conservation efforts in Imperial Valley, related particularly to conservation and agricultural easements and the recent Imperial County Renewable Energy and Transmission Element. If such geospatial data are available, Audubon will add the layers to the online map. Future phases of this project could include a partnership with San Diego Audubon Society on a Working Lands program with the agricultural community in Imperial Valley; advocacy on the conservation of Burrowing Owl in the Imperial Valley as a covered species in the DRECP biological goals, objectives, and conservation plans and actions; and advocacy on the Imperial County Renewable Energy planning ordinance Technical Advisory Committee. These future programs, which will be based on and informed by the science and research generated by funding from the Imperial Valley Community Foundation, will be sustained by grants we will seek to implement this program beyond this initial phase.

Our aim has been to provide information in an accessible, centralized location, including the Audubon website and Data Basin's DRECP Gateway, and to use this mapping tool for advocacy. For example, in our comment letter addressing the DRECP draft environmental documents, we pointed the DRECP authors to this map on our website for use in DRECP planning.

We aim to use the map in our Working Lands program in partnership with San Diego Audubon, and in advocacy with Imperial County Planning & Development Services. Burrowing Owl was selected as 2013 BIRD OF THE YEAR by Audubon members, and we have used – and will continue to use – that popularity to communicate the mapping tool widely throughout the Audubon network and to our members and supporters in California, the West and the U.S. through our communications vehicles.

## 12. Acknowledgements

Audubon thanks all stakeholders who generously provided data layers and/or feedback on the draft and final maps. Their data layers and thoughtful comments greatly improved the utility of this tool.

In particular, we'd like to thank the Imperial Valley Community Foundation for making this work possible. We'd also like to thank Bruce Wilcox, Kelly Bishop, and Jessica Lovecchio at IID for providing key datasets and instrumental feedback; Bob Wilkerson and IBP for providing important datasets and feedback; Michael Anguiano of AECOM for providing helpful feedback; Dan Rosenberg of Oregon Wildlife Institute and Oregon State University for providing constructive feedback; Derek Newland of the Imperial County Assessor's Office for sharing GIS data; Sarah Friedman of the Sierra Club for her feedback; Chris Gregory and Noelle Ronan for offering to display the map on their upcoming website, *The Burrow*; Tom Anderson and Chris Schoneman of the Sonny Bono Salton Sea National Wildlife Refuge for sharing data and feedback; the Cornell Lab of Ornithology for providing access to data from eBird; and Patrick McIntyre of California Department of Fish and Wildlife for providing critical data layers from CNDDDB.

This work is made possible through a partnership between Esri and the National Audubon Society to provide geospatial data and map production abilities to Audubon's 467 chapters, 47 education centers, and all 22 U.S. state offices (Esri 2013). Audubon is melding Esri's cutting-edge GIS mapping technology with the latest species data to study and reduce bird habitat losses and to plan conservation of birds. Each Audubon state office, nature center, and chapter has received Esri's ArcGIS software and access to a vast library of the latest authoritative data and scientific research via Esri's GIS cloud platform, ArcGIS Online.

We'd also like to thank the many others who contributed their time and expertise.

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## 14. Appendix A

*Table A-1 – Descriptions of Map Layers included in ArcGIS Online Burrowing Owl Map, with Citations*

<b>Layer Name</b>	<b>Description and Citation</b>
<i>Burrowing Owl Survey Data</i>	
IID ROW Burrowing Owl Survey (Limited), 2012	Burrowing Owl survey data from IID’s 2012 survey (AECOM 2012). This survey was focused on limited areas within the valley.
IID ROW Burrowing Owl Survey (Limited), 2011	Burrowing Owl survey data from IID’s 2011 survey (AECOM 2012). This survey was focused on limited areas within the valley.
IID ROW Burrowing Owl Survey (Valley-Wide), 2008	Burrowing Owl survey data from IID’s 2008 survey (Manning 2009). This survey was valley-wide.
IID ROW Burrowing Owl Survey (Valley-Wide), 2007	Burrowing Owl survey data from IID’s 2007 survey (Manning 2009). This survey was valley-wide.
IID ROW Burrowing Owl Survey (Limited), 2006	Burrowing Owl survey data from IID’s 2006 pilot study survey (Manning 2009). This survey was focused on limited areas within the valley.
Areas Surveyed in IID Surveys	Areas surveyed in IID’s 2007, 2008, 2011, and 2012 surveys, corresponding to Figures 1 and 2 (AECOM 2012), based on a shapefile of the survey blocks provided by IID staff.
Artificial Nest Box Survey, 2013 (Salton Sea NWR)	Survey data for artificial nest boxes installed within the Sonny Bono Salton Sea NWR, 2013, as provided by refuge staff.
Artificial Nest Box Survey, 2009 (Salton Sea NWR)	Survey data for artificial nest boxes installed within the Sonny Bono Salton Sea NWR, 2009, as provided by refuge staff.
Artificial Nest Box Survey, 2008 (Salton Sea NWR)	Survey data for artificial nest boxes installed within the Sonny Bono Salton Sea NWR, 2008, as provided by refuge staff.
Burrowing Owl Survey Records, 2007 (IBP)	Burrowing Owl survey data from IBP’s 2007 survey (Wilkerson and Siegel 2010), as provided by B. Wilkerson. This survey was focused on limited areas within the valley.
Burrowing Owl Survey Records, 2006 (IBP)	Burrowing Owl survey data from IBP’s 2006 survey (Wilkerson and Siegel 2010), as provided by B. Wilkerson. This survey was focused on limited areas within the valley.
Areas Surveyed in IBP Surveys	Areas surveyed in IBP’s 2006 and 2007 surveys, corresponding to Figure 11 (Wilkerson and Siegel 2010), as provided by B. Wilkerson.
CNDDDB Burrowing Owl Records, 2009	Burrowing Owl records for 2009 from CNDDDB (California Department of Fish and Wildlife 2014).
CNDDDB Burrowing Owl Records, 2008	Burrowing Owl records for 2008 from CNDDDB (California Department of Fish and Wildlife 2014).

CNDDDB Burrowing Owl Records, 2007	Burrowing Owl records for 2007 from CNDDDB (California Department of Fish and Wildlife 2014).
CNDDDB Burrowing Owl Records, 2006	Burrowing Owl records for 2006 from CNDDDB (California Department of Fish and Wildlife 2014).
CNDDDB Burrowing Owl Records, 2005	Burrowing Owl records for 2005 from CNDDDB (California Department of Fish and Wildlife 2014).
BBS Burrowing Owl Records, 2013 (USGS)	Burrowing Owl records for the 2013 Breeding Bird Survey (BBS) (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2012 (USGS)	Burrowing Owl records for the 2012 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2011 (USGS)	Burrowing Owl records for the 2011 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2010 (USGS)	Burrowing Owl records for the 2010 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2009 (USGS)	Burrowing Owl records for the 2009 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2008 (USGS)	Burrowing Owl records for the 2008 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2007 (USGS)	Burrowing Owl records for the 2007 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2006 (USGS)	Burrowing Owl records for the 2006 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2005 (USGS)	Burrowing Owl records for the 2005 BBS (United States Geological Survey 2014).
BBS Burrowing Owl Records, 2004 (USGS)	Burrowing Owl records for the 2004 BBS (United States Geological Survey 2014).
eBird Burrowing Owl Records, 2004-14	Burrowing Owl records for January 2004 through August 2014 from eBird (Cornell Lab of Ornithology 2014). Only approved observations are included.
<i>Supporting Layers</i>	
IID Canals	Canals in IID, as provided by IID staff. Canals can be concrete or earthen (indicated by symbols in the map).
IID Drains (all earthen)	Drains in IID, as provided by IID staff. All IID drains are earthen.
IID Reservoirs	Reservoirs in IID, as provided by IID staff.
Available Burrows, 2008 (IID)	Available burrows for Burrowing Owls in 2008, as provided by IID staff and using methodology described in (Manning 2009).
Available Burrows, 2007 (IID)	Available burrows for Burrowing Owls in 2007, as provided by IID staff and using methodology described in (Manning 2009).
Protected Areas (CPAD)	California Protected Areas Database, version 2013b (GreenInfo Network 2013), clipped to Imperial Valley.
Geothermal Power Plants	Geothermal power plants as provided by Imperial County Assessor's Office staff. Current as of March 2015.
Solar Power Plants	Solar power plants as provided by Imperial County Assessor's Office staff. Current as of March 2015.
DRECP Boundary	DRECP Plan Area, corresponding to the December 10, 2014 Draft DRECP and EIR/EIS (DRECP 2014).
Imperial Valley	Imperial County Important Bird Area boundary. More information available



Important Bird Area	here: <a href="http://netapp.audubon.org/iba/site/269">http://netapp.audubon.org/iba/site/269</a> .
Draft DRECP Preferred Alternative Designations	DRECP Development Focus Areas and Conservation Planning Areas associated with the Preferred Alternative, corresponding to the December 10, 2014 Draft DRECP and EIR/EIS (DRECP 2014).
Imperial County Important Farmland (2012)	Imperial County farmland value (California Department of Conservation: Division of Land Resource Protection: Farmland Mapping and Monitoring Program 2012).
Suitability of Soils for Burrowing Owls	Soils categorized according to Burrowing Owl suitability (Manning 2009), provided by IID staff.
Crops, 2013 (USDA)	Cropland in 2013 from the USDA's CropScape web platform (United States Department of Agriculture 2014) and clipped to the Imperial Valley.
Crops, 2012 (USDA)	Cropland in 2012 from the USDA's CropScape web platform (United States Department of Agriculture 2014) and clipped to the Imperial Valley.
Crops, 2011 (USDA)	Cropland in 2011 from the USDA's CropScape web platform (United States Department of Agriculture 2014) and clipped to the Imperial Valley.
Crops, 2010 (USDA)	Cropland in 2010 from the USDA's CropScape web platform (United States Department of Agriculture 2014) and clipped to the Imperial Valley.
Crops, 2009 (USDA)	Cropland in 2009 from the USDA's CropScape web platform (United States Department of Agriculture 2014) and clipped to the Imperial Valley.
Crops, 2008 (USDA)	Cropland in 2008 from the USDA's CropScape web platform (United States Department of Agriculture 2014) and clipped to the Imperial Valley.
Crops, 2007 (USDA)	Cropland in 2007 from the USDA's CropScape web platform (United States Department of Agriculture 2014) and clipped to the Imperial Valley.
Crops, 2006 (IID)	Cropland in 2006, as provided by IID staff. Methodology described in Appendix III of (Manning 2009).
Crops, 2005 (IID)	Cropland in 2005, as provided by IID staff. Methodology described in Appendix III of (Manning 2009).
Crops, 2004 (IID)	Cropland in 2004, as provided by IID staff. Methodology described in Appendix III of (Manning 2009).
Crops, 2003 (IID)	Cropland in 2003, as provided by IID staff. Methodology described in Appendix III of (Manning 2009).

**Table A-2 – Sources and Metadata for Map Layers**

Layer Name	Source	Metadata
<i>Burrowing Owl Survey Data</i>		
IID ROW Burrowing Owl Survey (Limited), 2012	IID	<a href="http://audubon.maps.arcgis.com/home/item.html?id=b082b75df536463b927c2898fa676740">http://audubon.maps.arcgis.com/home/item.html?id=b082b75df536463b927c2898fa676740</a>
IID ROW Burrowing Owl Survey (Limited), 2011		
IID ROW Burrowing Owl Survey (Valley-Wide), 2008		
IID ROW Burrowing Owl Survey (Valley-Wide), 2007		
IID ROW Burrowing Owl Survey (Limited),		

2006		
Areas Surveyed in IID Surveys		<a href="http://audubon.maps.arcgis.com/home/item.html?id=2e815716ad3d4e749755a4d16d92cf01">http://audubon.maps.arcgis.com/home/item.html?id=2e815716ad3d4e749755a4d16d92cf01</a>
Artificial Nest Box Survey, 2013 (Salton Sea NWR)	Sonny Bono Salton Sea NWR	<a href="http://audubon.maps.arcgis.com/home/item.html?id=fd57d517ae89403ca7381dfedc650a94">http://audubon.maps.arcgis.com/home/item.html?id=fd57d517ae89403ca7381dfedc650a94</a>
Artificial Nest Box Survey, 2009 (Salton Sea NWR)		
Artificial Nest Box Survey, 2008 (Salton Sea NWR)		
Burrowing Owl Survey Records, 2007 (IBP)	IBP	<a href="http://audubon.maps.arcgis.com/home/item.html?id=4fb9c437ebbc42ce98e2d82773c6500d">http://audubon.maps.arcgis.com/home/item.html?id=4fb9c437ebbc42ce98e2d82773c6500d</a>
Burrowing Owl Survey Records, 2006 (IBP)		
Areas Surveyed in IBP Surveys		
CNDDDB Burrowing Owl Records, 2009	CNDDDB	<a href="http://audubon.maps.arcgis.com/home/item.html?id=6763ccd812154821a76d9ff804a7874c">http://audubon.maps.arcgis.com/home/item.html?id=6763ccd812154821a76d9ff804a7874c</a>
CNDDDB Burrowing Owl Records, 2008		
CNDDDB Burrowing Owl Records, 2007		
CNDDDB Burrowing Owl Records, 2006		
CNDDDB Burrowing Owl Records, 2005		
BBS Burrowing Owl Records, 2013 (USGS)	USGS	<a href="http://audubon.maps.arcgis.com/home/item.html?id=0788f51d0e7943ae8a0cabac3b32ae7c">http://audubon.maps.arcgis.com/home/item.html?id=0788f51d0e7943ae8a0cabac3b32ae7c</a>
BBS Burrowing Owl Records, 2012 (USGS)		
BBS Burrowing Owl Records, 2011 (USGS)		
BBS Burrowing Owl Records, 2010 (USGS)		
BBS Burrowing Owl Records, 2009 (USGS)		
BBS Burrowing Owl Records, 2008 (USGS)		
BBS Burrowing Owl Records, 2007 (USGS)		
BBS Burrowing Owl Records, 2006 (USGS)		
BBS Burrowing Owl Records, 2005 (USGS)		
BBS Burrowing Owl Records, 2004 (USGS)		
eBird Burrowing Owl Records, 2004-14	eBird	<a href="http://audubon.maps.arcgis.com/home/item.html?id=a80bdb0a05a542c38c948ee6949610a9">http://audubon.maps.arcgis.com/home/item.html?id=a80bdb0a05a542c38c948ee6949610a9</a>
<i>Supporting Layers</i>		
IID Canals	IID	<a href="http://audubon.maps.arcgis.com/home/item.html?id=1a7f980a601e4839baa1a19f58895cb3">http://audubon.maps.arcgis.com/home/item.html?id=1a7f980a601e4839baa1a19f58895cb3</a>
IID Drains (all earthen)		
IID Reservoirs		
Available Burrows, 2008 (IID)		
Available Burrows, 2007 (IID)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=d867e20825ab4676bd6cb1ce9f9f9ea2">http://audubon.maps.arcgis.com/home/item.html?id=d867e20825ab4676bd6cb1ce9f9f9ea2</a>
Protected Areas (CPAD)	CPAD	<a href="http://audubon.maps.arcgis.com/home/item.html?id=9e3d25ebde4d42e89d5f55136a26eaba">http://audubon.maps.arcgis.com/home/item.html?id=9e3d25ebde4d42e89d5f55136a26eaba</a>
Geothermal Power Plants	Imperial County	<a href="http://audubon.maps.arcgis.com/home/item.html?id=d1e32fd4839944659a705e">http://audubon.maps.arcgis.com/home/item.html?id=d1e32fd4839944659a705e</a>

	Assessor's Office	7b5961d403 <a href="http://audubon.maps.arcgis.com/home/item.html?id=616f602366b2436aa037820238c896c7">http://audubon.maps.arcgis.com/home/item.html?id=616f602366b2436aa037820238c896c7</a>
Solar Power Plants		
DRECP Boundary	DRECP	<a href="http://audubon.maps.arcgis.com/home/item.html?id=c72626c9bcaf47d2a9661d2c86e87873">http://audubon.maps.arcgis.com/home/item.html?id=c72626c9bcaf47d2a9661d2c86e87873</a>
Imperial Valley Important Bird Area	Audubon	<a href="http://audubon.maps.arcgis.com/home/item.html?id=9fe091414f07489aa2df85c4302cb5e4">http://audubon.maps.arcgis.com/home/item.html?id=9fe091414f07489aa2df85c4302cb5e4</a>
Draft DRECP Preferred Alternative Designations	DRECP	<a href="http://audubon.maps.arcgis.com/home/item.html?id=ec05d7852c36448a8d08b0d9a6c31f29">http://audubon.maps.arcgis.com/home/item.html?id=ec05d7852c36448a8d08b0d9a6c31f29</a>
Imperial County Important Farmland (2012)	California Department of Conservation	<a href="http://audubon.maps.arcgis.com/home/item.html?id=8ea9f8a7318d41aab5d2c521838e6711">http://audubon.maps.arcgis.com/home/item.html?id=8ea9f8a7318d41aab5d2c521838e6711</a>
Suitability of Soils for Burrowing Owls	IID	<a href="http://audubon.maps.arcgis.com/home/item.html?id=029c8809f562422fbe3e80f2384edf40">http://audubon.maps.arcgis.com/home/item.html?id=029c8809f562422fbe3e80f2384edf40</a>
Crops, 2013 (USDA)	USDA	<a href="http://audubon.maps.arcgis.com/home/item.html?id=144709985c704858bb974fe1d423feb6">http://audubon.maps.arcgis.com/home/item.html?id=144709985c704858bb974fe1d423feb6</a>
Crops, 2012 (USDA)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=961d42bd50e54e9883d0c157acdb3be1">http://audubon.maps.arcgis.com/home/item.html?id=961d42bd50e54e9883d0c157acdb3be1</a>
Crops, 2011 (USDA)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=06ccbb3f85e43acb26e60299f27c7cc">http://audubon.maps.arcgis.com/home/item.html?id=06ccbb3f85e43acb26e60299f27c7cc</a>
Crops, 2010 (USDA)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=1cc10d42fd30490b9ab6b3f81ec072a7">http://audubon.maps.arcgis.com/home/item.html?id=1cc10d42fd30490b9ab6b3f81ec072a7</a>
Crops, 2009 (USDA)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=1bbe5083e17640449d9474b6465ce078">http://audubon.maps.arcgis.com/home/item.html?id=1bbe5083e17640449d9474b6465ce078</a>
Crops, 2008 (USDA)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=bad5f9f074d243389aefd2b2f5e28756">http://audubon.maps.arcgis.com/home/item.html?id=bad5f9f074d243389aefd2b2f5e28756</a>
Crops, 2007 (USDA)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=11e1a5bcccd14e01b06f21100db12785">http://audubon.maps.arcgis.com/home/item.html?id=11e1a5bcccd14e01b06f21100db12785</a>
Crops, 2006 (IID)		IID
Crops, 2005 (IID)	<a href="http://audubon.maps.arcgis.com/home/item.html?id=52099cf3466b4424bb7d48ceacb24732">http://audubon.maps.arcgis.com/home/item.html?id=52099cf3466b4424bb7d48ceacb24732</a>	

Crops, 2004 (IID)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=412f54825c3d4a7191ba105192761fb3">http://audubon.maps.arcgis.com/home/item.html?id=412f54825c3d4a7191ba105192761fb3</a>
Crops, 2003 (IID)		<a href="http://audubon.maps.arcgis.com/home/item.html?id=2be33f6406e64be498f9e74c8eecffc8">http://audubon.maps.arcgis.com/home/item.html?id=2be33f6406e64be498f9e74c8eecffc8</a>

*Table A-3 – Suggested Layers Excluded from the Map and Analysis*

<b>Reason</b>	<b>Suggested Layers Excluded</b>
No known features within Imperial Valley	Existing wind turbines
	Conservation easements (using GreenInfo Network’s CCED v. 2015a dataset available at: <a href="http://www.calands.org/cced">http://www.calands.org/cced</a> )
Not relevant	Other data layers provided by IID
Beyond the scope of this project / Data not available	Productivity / dates and successes of nesting attempts / number of fledged offspring
	Follow-up results of owls that have been displayed and/or moved to artificial burrows
	Foraging areas of Burrowing Owls
	Consultants’ documented observations
	Location of pesticide sampling
	Streams and/or canal ditches with banks appropriate for burrows (note: we have included IID drains and canals, as well as counts of “available burrows” as estimated in 2007 and 2008 surveys by IID)
	Other proposed large-scale development other than renewable energy projects
	Areas under consideration for protection
	IID fallowing program (note: the USDA Croplands layer, which is displayed in the map and used in the analyses, includes fallowed lands)
	Water rights
	Type of irrigation used