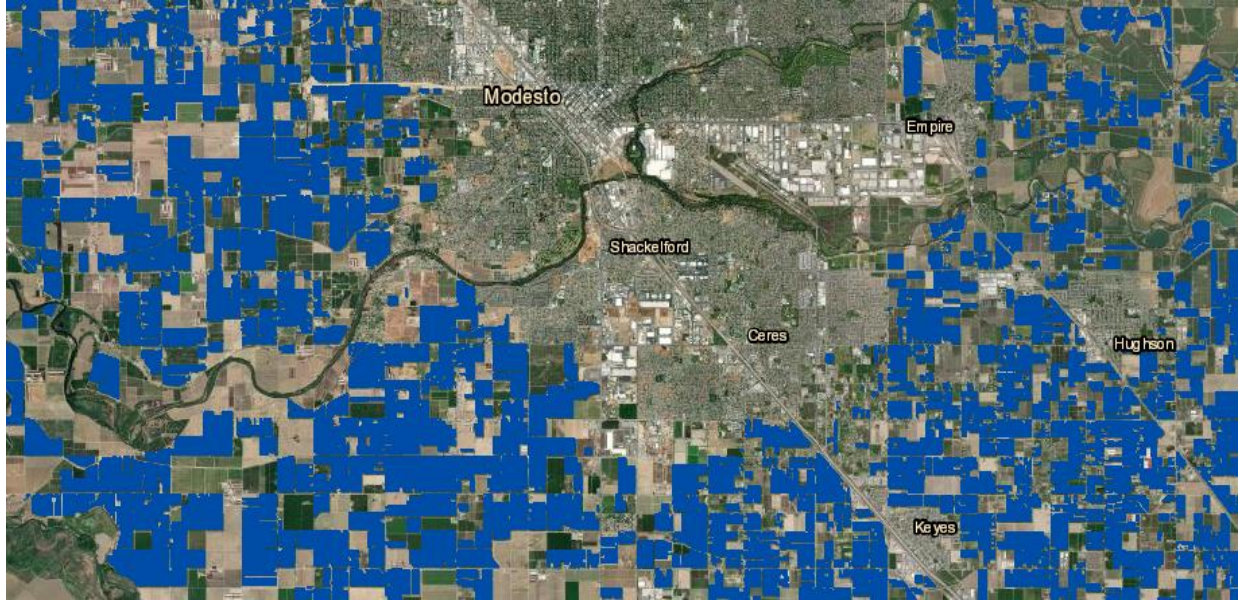
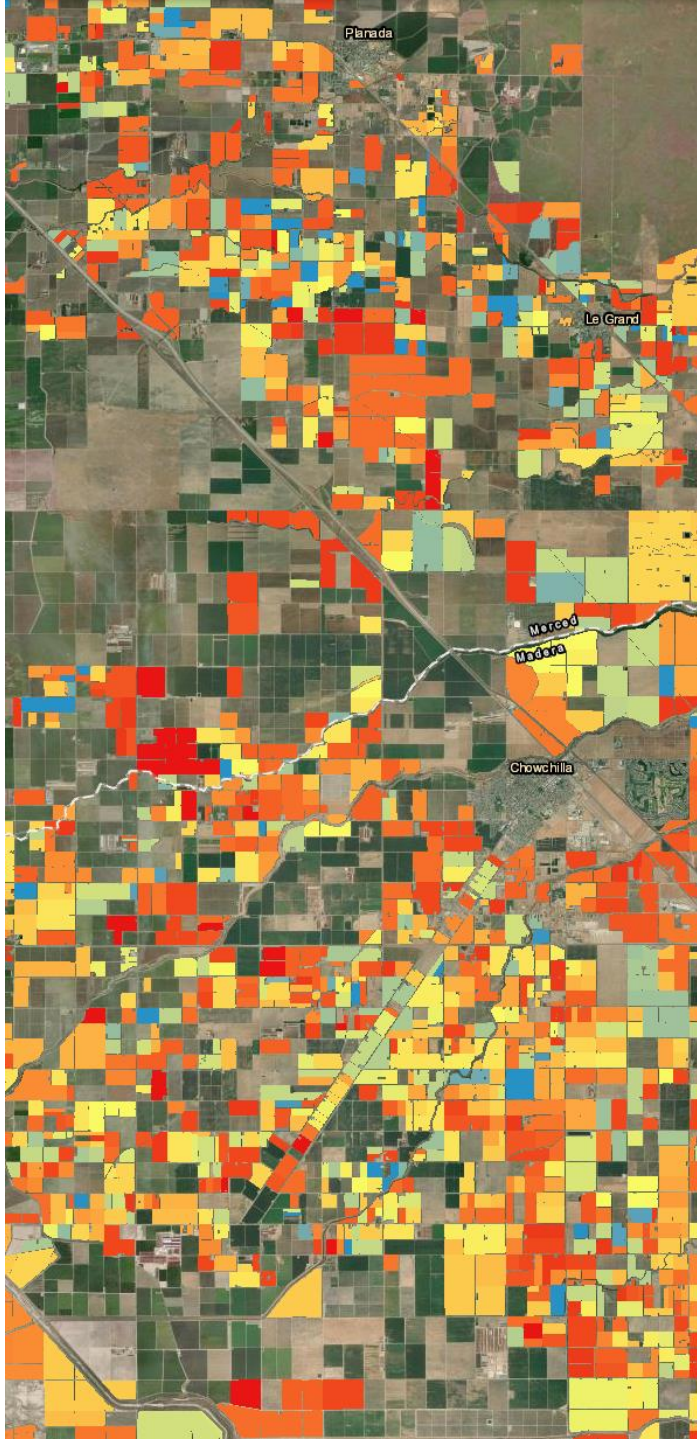




STATEWIDE ALMOND ACREAGE MAPPING AND SUMMARY

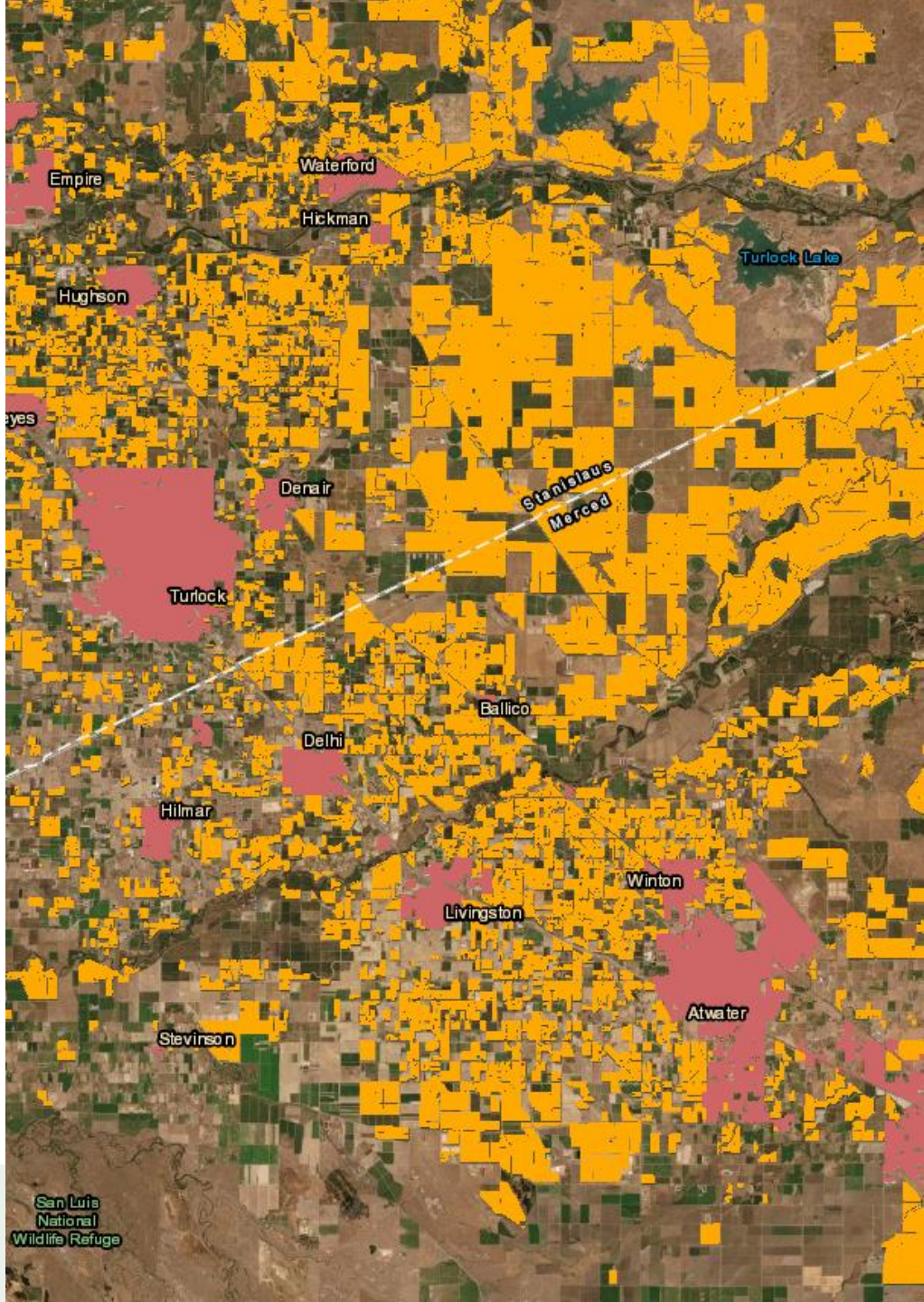
ASFMRA
SINCE 1929
American Society of Farm Managers & Rural Appraisers
CALIFORNIA CHAPTER

LAND IQ

MAY 20, 2021

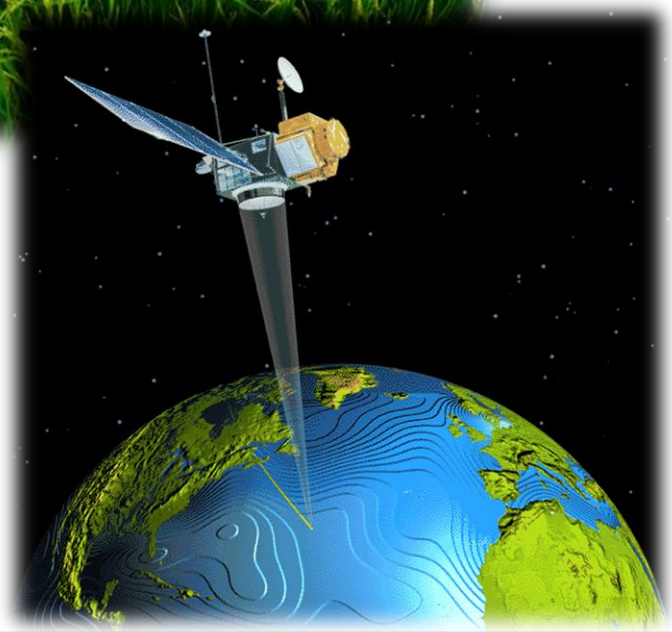
DISCUSSION TOPICS

- Land IQ background
- How this all started: the grower-driven interest
- Historical summary on mapping almonds and determining acreage
- Why spatial mapping is important?
- Applications of the data
- Where can you access the numerical and spatial information?
- The future impacts of SGMA: What do we really know?



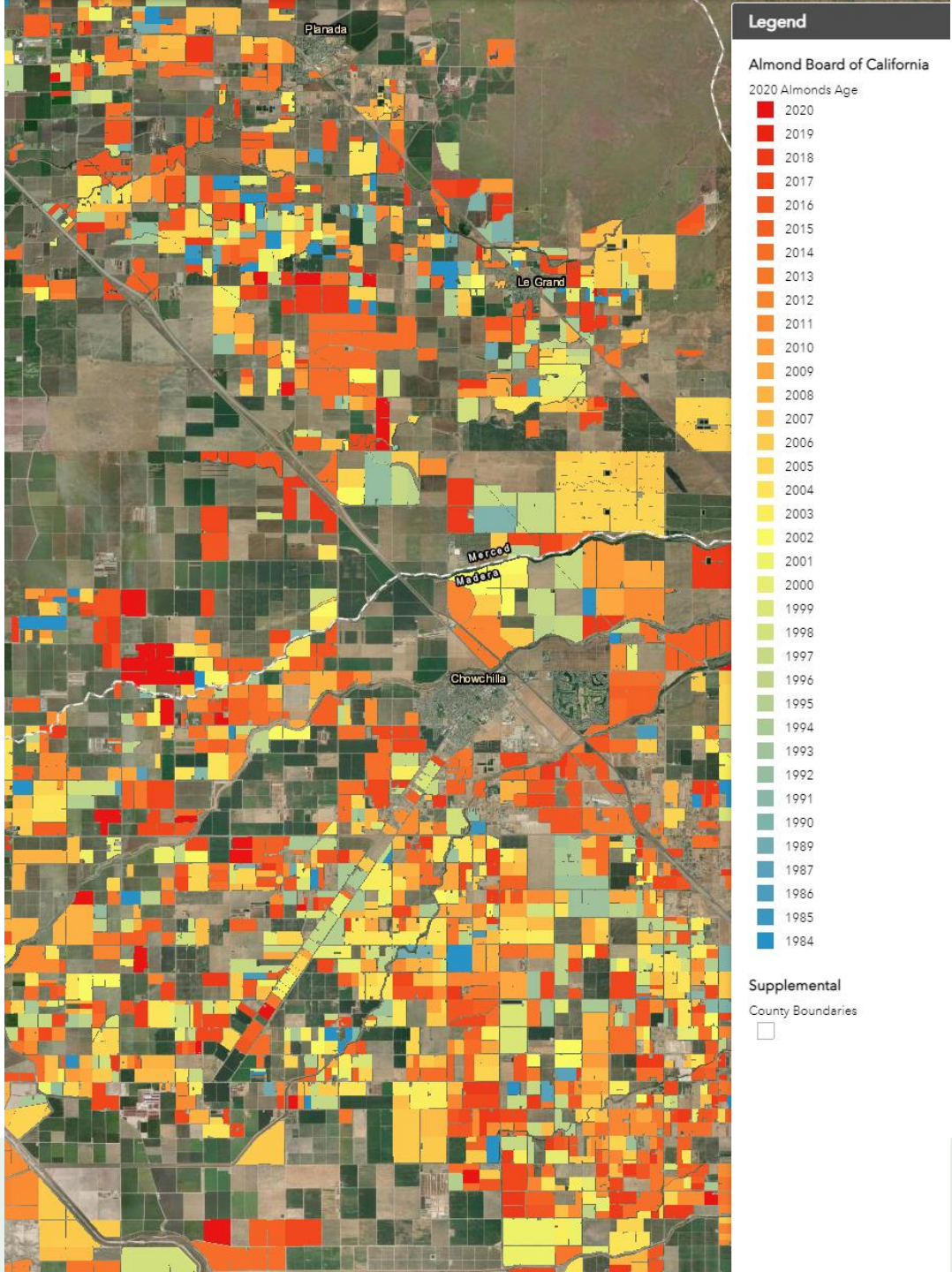
LAND IQ TECHNICAL DISCIPLINES

- Land-Based Scientists - Agricultural
  - Land use mapping and crop consumptive use
  - Crop production and nutrient management
  - Agricultural water quality and quantity evaluation
  - Salinity management
  - Agricultural reuse
  - Regulatory support
  - Land stabilization and erosion control
- Spatial Scientists - Remote Sensing and GIS
  - Consumptive use estimation and crop identification
  - Large landscape evaluations
  - Irrigation and drainage
  - Production agriculture



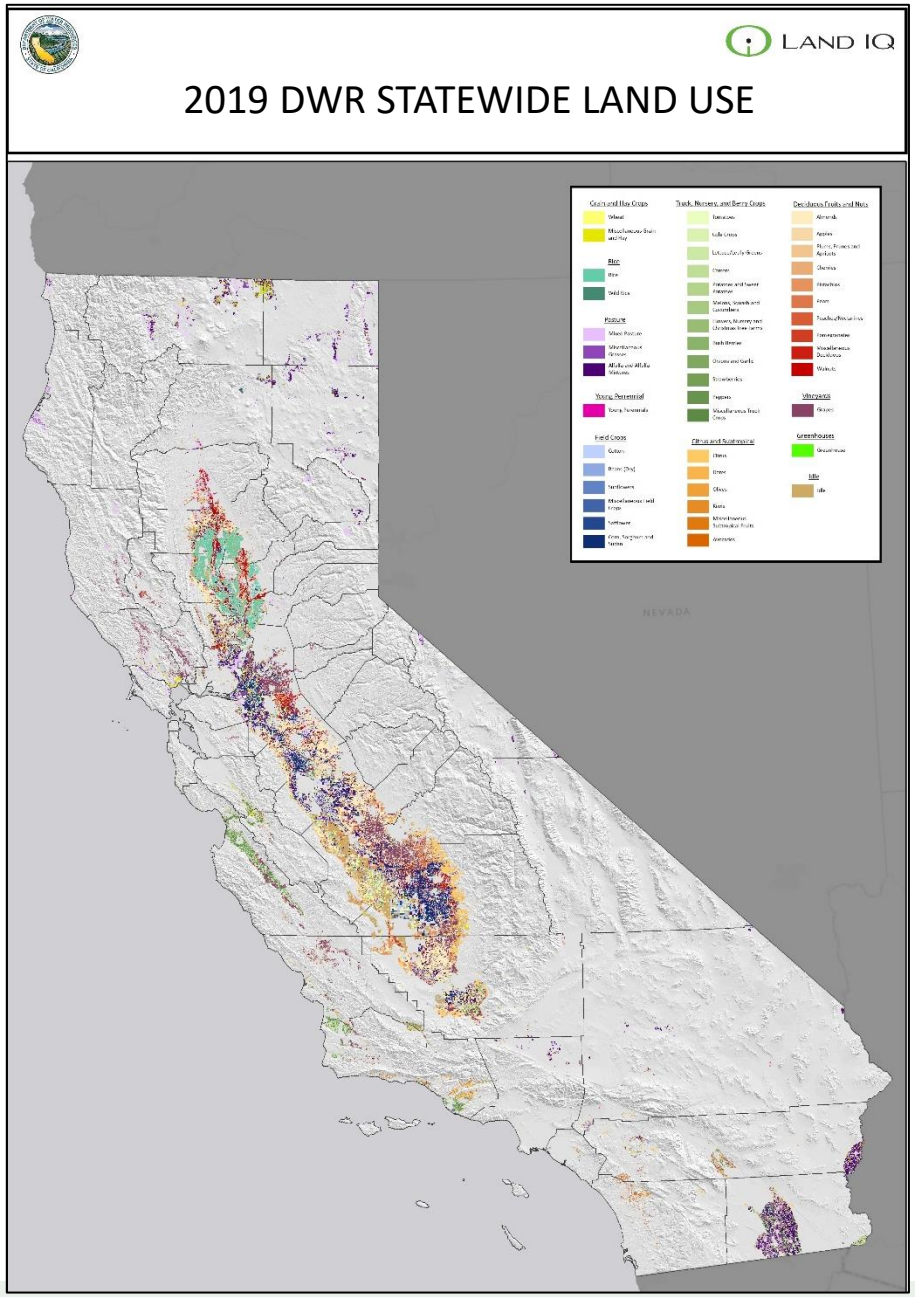
HOW THIS ALL STARTED

- Started back in 2011
- Land IQ was doing some other “spatial” work for the ABC
- During a time of rapid almond acreage growth
- Growers on the Board of the ABC suspected acreage was too low
- “I think I’m a good farmer, but I can’t even achieve reported average yields.” (pounds/acre)



STATEWIDE LAND USE

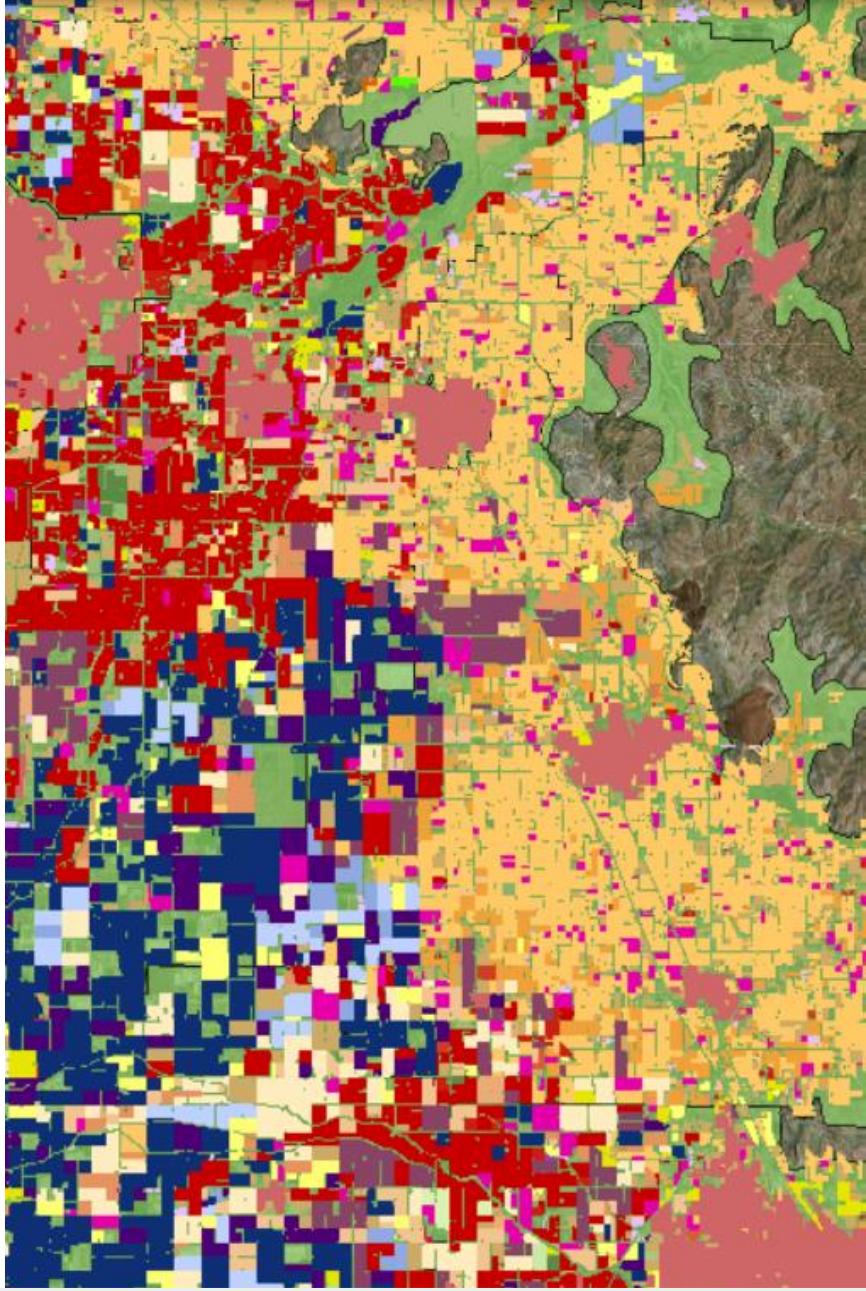
- Over 406,000 individually classified polygons (fields)
- Major land use categories classified as of 2019
  - Agriculture = 9.55 million acres
  - Urban = 4.87 million acres
- Agriculture – includes both irrigated and fallow fields and only the irrigated area within those fields
- Urban – classified at the outer land use boundary between urban and another land use

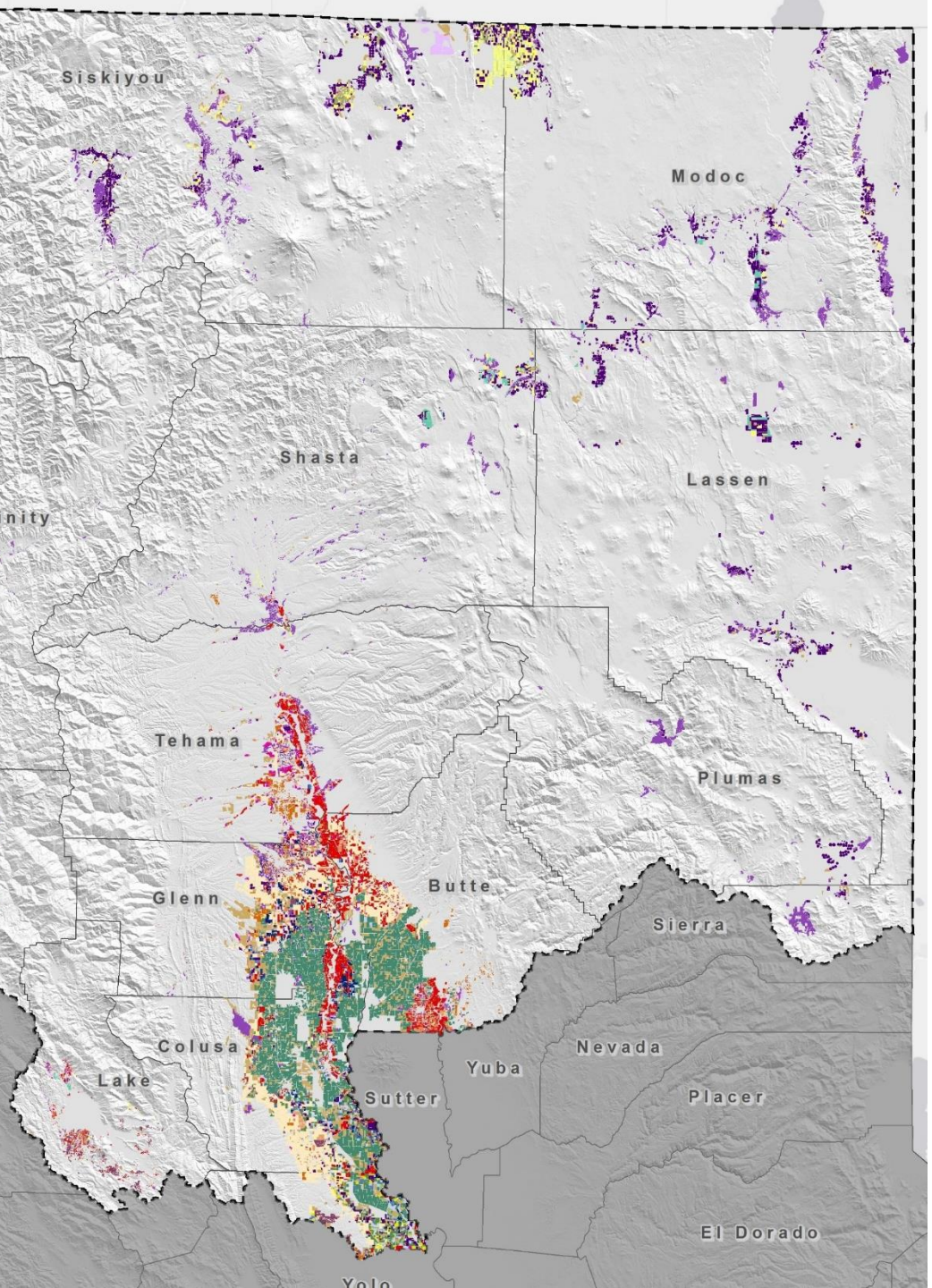


LAND IQ

STATEWIDE LAND USE

- Minimum field size of 2.0 acres – many times less
- Over 15,000 miles of ground truthing each year
- Overall accuracy of 97.6% (2016) based on independent ground-truth validation dataset
- Approximately 50 crop legend categories, which represent 98% of all irrigated lands
- Cross-walked with DWR legend

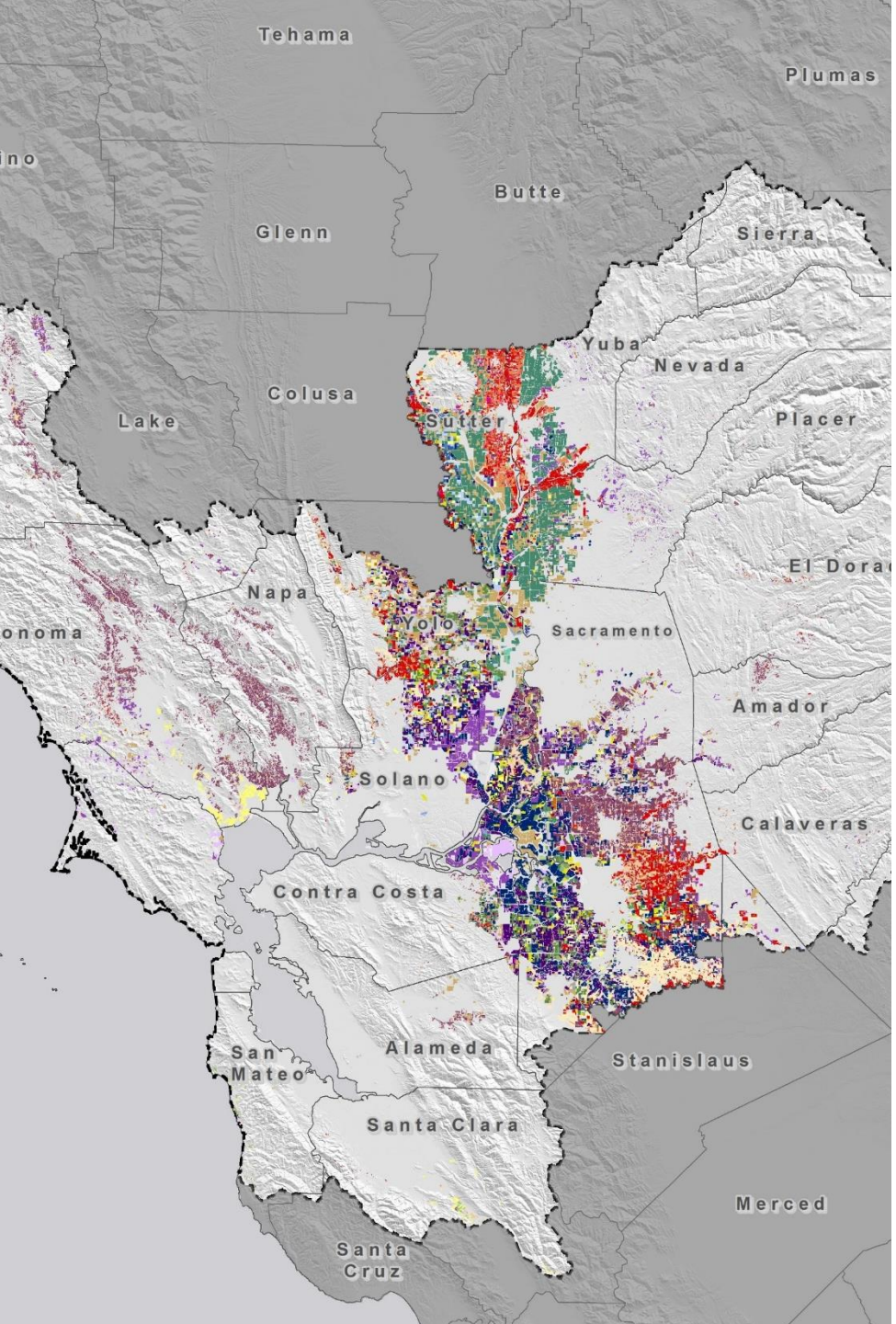




CA - DWR
Northern Region

- Major crops include:
  - Rice, Walnuts, Almonds, Alfalfa, Mixed Pasture, Prunes, Grapes, Olives
  - Total Irrigated & Idle Land = 1,492,979

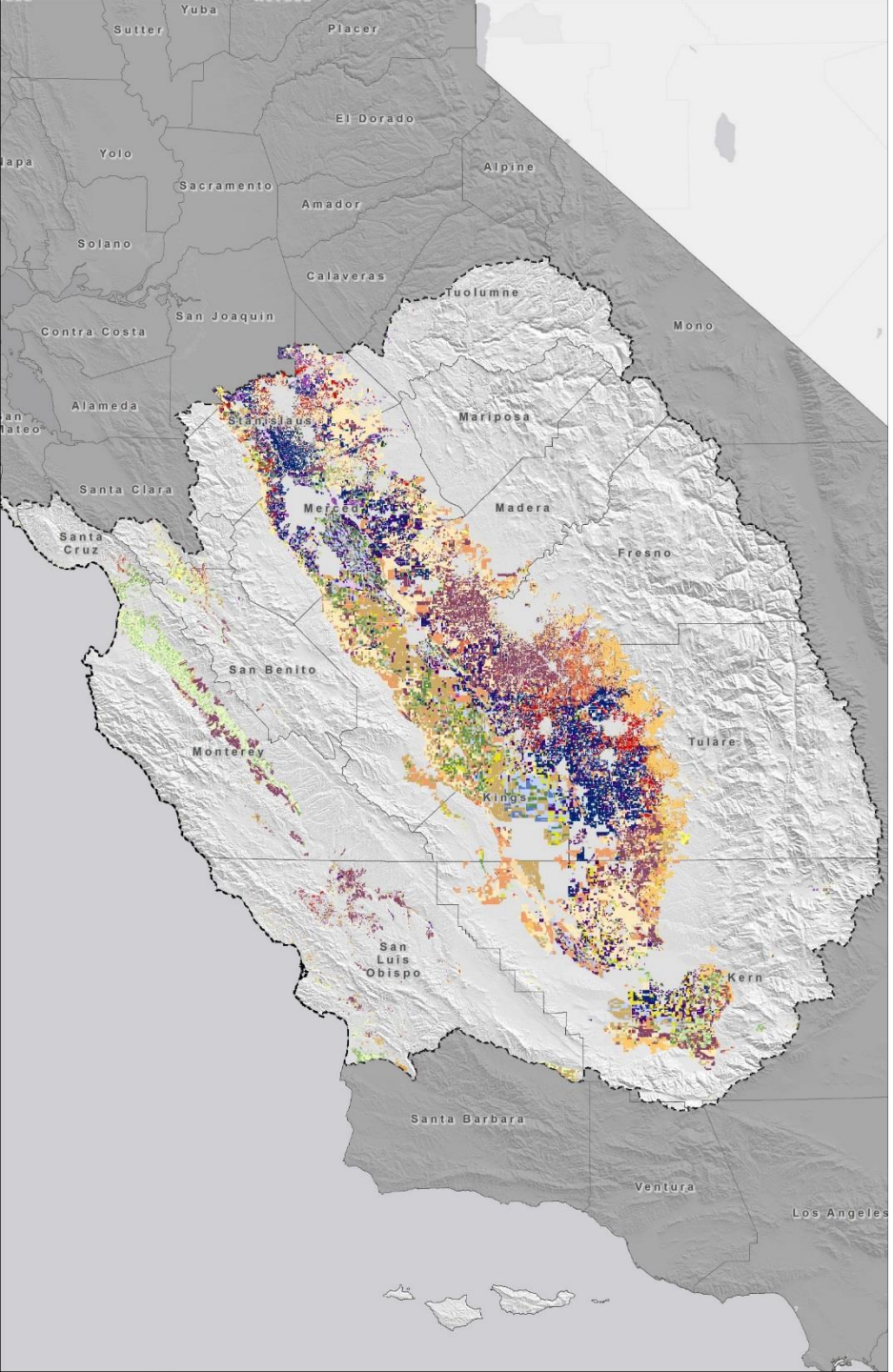
LAND IQ



CA - DWR
North Central Region

- Major crops include:
  - Grapes, Almonds, Walnuts, Corn, Alfalfa, Tomatoes, Mixed Pasture, Fallow
  - Total Irrigated & Idle Land = 1,664,941 acres

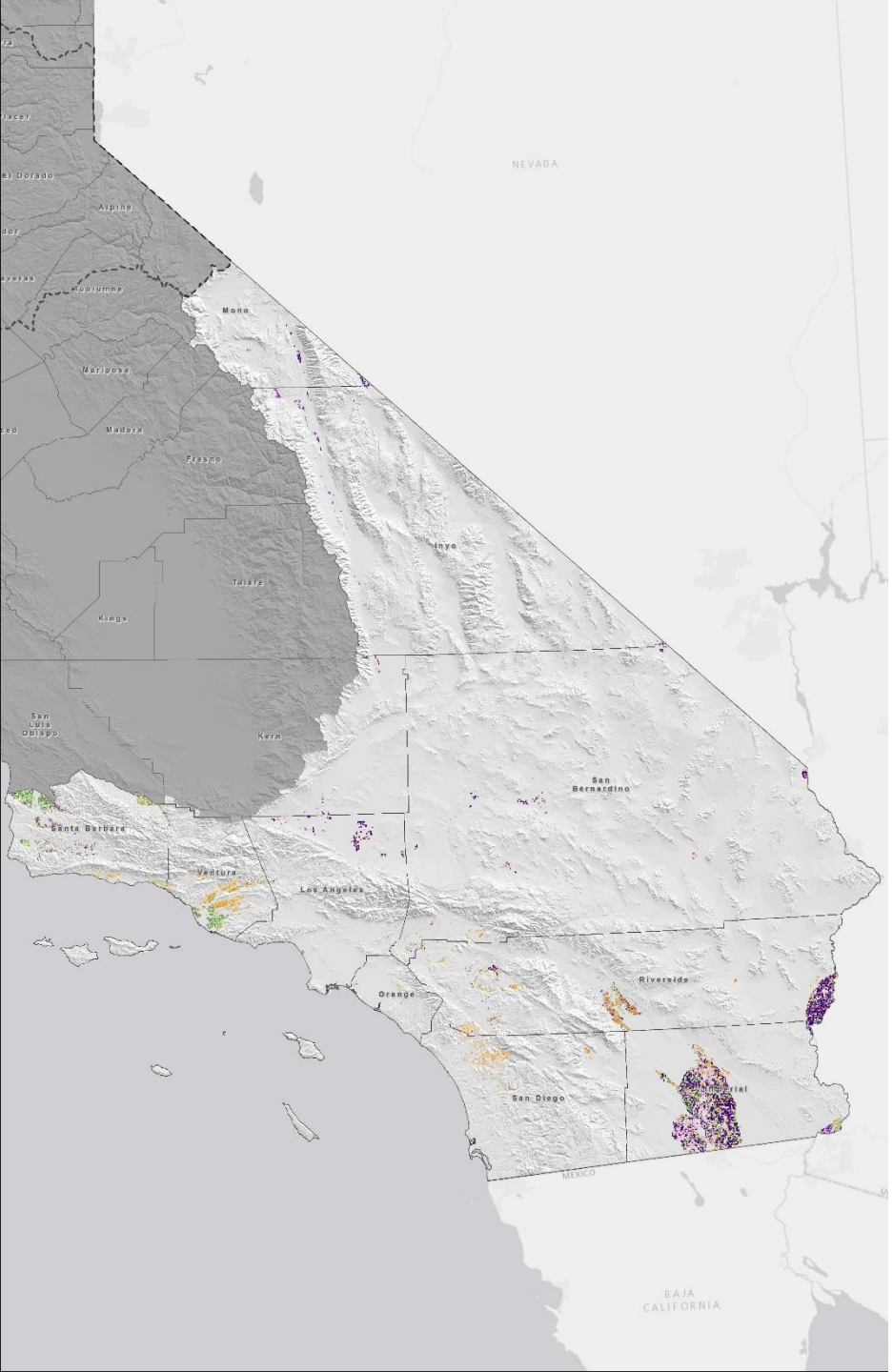
LAND IQ



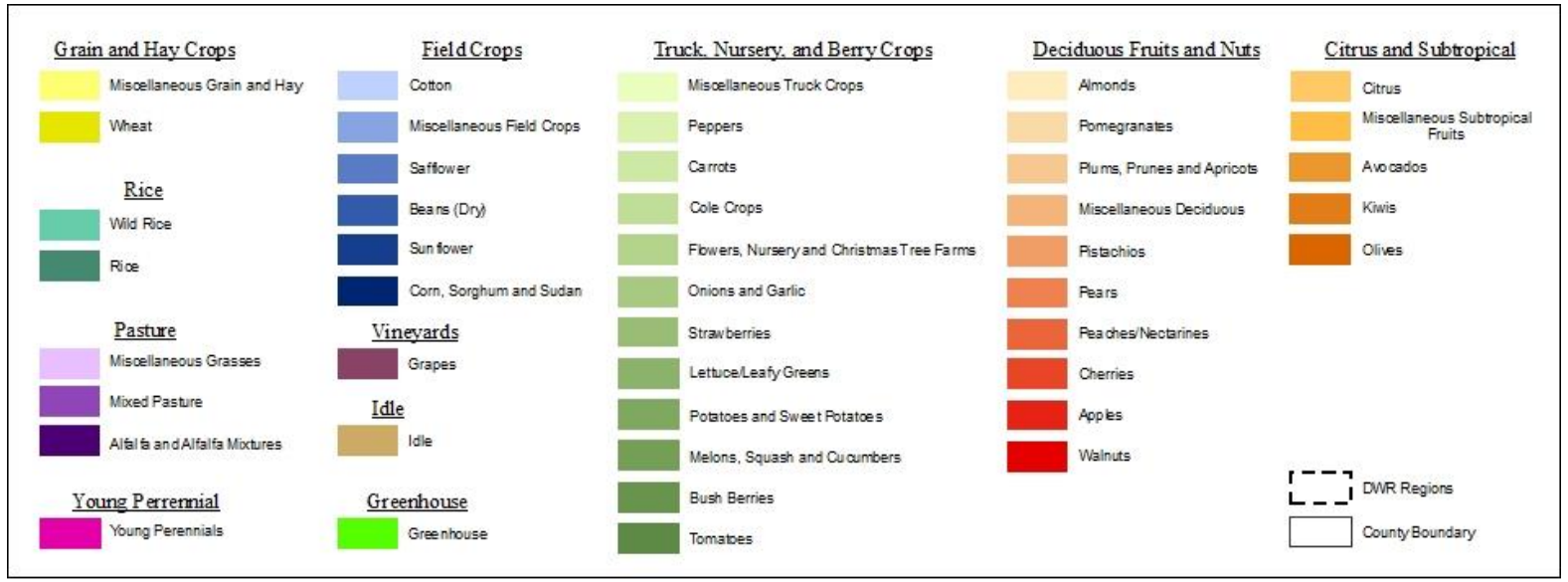
CA – DWR
South Central Region

- Major crops include:
  - Grapes, Almonds, Pistachios, Citrus, Walnuts, Corn, Sorghum, Cotton, Alfalfa, Tomatoes, Wheat, Fallow
  - Total Irrigated & Idle Land = 4,829,004 acres

LAND IQ



CA – DWR
SOUTHERN REGION



- Major crops include:
  - Alfalfa, Citrus, Avocados, Cole Crops, Lettuce/Leafy Greens, Carrots, Truck Crops, Strawberries
  - Total Irrigated & Idle Land = 949,504 acres

DEPARTMENT OF WATER RESOURCES
STATE OF CALIFORNIA

LAND IQ

Table 9. WY 2018 Statewide Land Use Mapping Accuracy and Precision by Crop

Crop Class	User's Accuracy (Number of correctly classified acres/total acres)	Number of Groundtruth (Reference Sample Acres)	95% Two-tailed Confidence Interval
Almonds	100%	74,441	0%
Cherries	100%	10,940	0%
Dates	100%	12,575	0%
Kiwis	100%	183	0%
Olives	100%	2,886	0%
Pistachios	100%	16,243	0%
Rice	100%	862	0%
Young Perennials	100%	26,210	0%
Plums, Prunes and Apricots	100%	22,648	0%
Sunflowers	100%	29,491	0%
Walnuts	100%	40,315	0%
Pomegranates	100%	2,572	0%
Grapes	99%	3,635	0%
Citrus	99%	3,010	0%
Tomatoes	99%	35,209	0%
Cotton	99%	3,730	
Peaches/Nectarines	98%	12,478	
Mixed Pasture	97%	27,851	
Corn, Sorghum and Sudan	97%	37,381	
Potatoes or Sweet Potatoes	97%	1,416	
Alfalfa and Alfalfa Mixtures	96%	393	
Miscellaneous Field Crops	96%	1,760	
Avocados	96%	2,565	
Unclassified Fallow	96%	4,052	
Carrots	96%	606	
Beans (Dry)	95%	2,580	
Bush Berries	95%	5,847	
Onions and Garlic	95%	2,716	
Pears	94%	4,128	
Melons, Squash and Cucumbers	92%	1,998	
Miscellaneous Grain and Hay	92%	2,617	
Safflower	91%	12,429	
Strawberries	91%	7,179	
Apples	89%	11,615	
Lettuce/Leafy Greens	85%	4,297	
Peppers	82%	6,713	
Flowers, Nursery and Christmas Tree Farms	80%	265	
Cole Crops	79%	766	
Miscellaneous Truck Crops	71%	622	
Miscellaneous Grasses	67%	1,469	
Miscellaneous Deciduous	58%	333	
Miscellaneous Subtropical Fruits	48%	32	

STATEWIDE ACCURACIES

- Overall accuracy of 97.6% based on independent ground-truth validation dataset for specific crop type.
- Overall accuracy of 98.3% based on independent ground-truth validation dataset for grouped crop type.
- Mapping completed for 2014, 2016, 2018, 2019, 2020
- No crop is ever 100% accurate – including almonds

		Predicted														
		Citrus and Subtropical	Deciduous Fruits and Nuts	Field Crops	Grain and Hay Crops	Pasture	Rice	Truck, Nursery and Berry Crops	Unclassified	Vineyard	Young Perennial	Total Acres	Correct Acres	Incorrect Acres	% Correct	Commission Error
Reference	Citrus and Subtropical	16,000	1	-	-	-	-	8	65	-	-	16,074	16,000	74	99.5%	0.5%
	Deciduous Fruits and Nuts	9	122,914	-	-	-	-	-	214	3	35	123,175	122,914	261	99.8%	0.2%
	Field Crops	-	5	57,185	-	560	-	668	21	-	-	58,439	57,185	1,254	97.9%	2.1%
	Grain and Hay Crops	-	-	258	37,201	159	-	683	1,456	-	-	39,757	37,201	2,556	93.6%	6.4%
	Pasture	-	-	393	309	38,115	-	7	317	-	-	39,141	38,115	1,026	97.4%	2.6%
	Rice	-	-	-	-	-	26,210	-	-	-	-	26,210	26,210	-	100.0%	0.0%
	Truck, Nursery and Berry Crops	3	-	335	118	176	-	62,335	19	23	1	63,010	62,335	675	98.9%	1.1%
	Unclassified	-	46	-	-	1,070	-	7	35,873	188	196	37,380	35,873	1,507	96.0%	4.0%
	Vineyard	-	-	-	-	5	-	-	80	29,320	74	29,479	29,320	159	99.5%	0.5%
	Young Perennial	-	-	-	-	-	-	-	-	-	4,128	4,128	4,128	-	100.0%	0.0%
	Total Acres	16,012	122,966	58,171	37,628	40,085	26,210	63,708	38,045	29,534	4,434	436,793				
	Correct Acres	16,000	122,914	57,185	37,201	38,115	26,210	62,335	35,873	29,320	4,128		429,281			
	Incorrect Acres	12	52	986	427	1,970	-	1,373	2,172	214	306			7,512		
	% Correct	99.9%	100.0%	98.3%	98.9%	95.1%	100.0%	97.8%	94.3%	99.3%	93.1%				98.3%	
	Commission Error	0.1%	0.0%	1.7%	1.1%	4.9%	0.0%	2.2%	5.7%	0.7%	6.9%					

DEMONSTRATION OF MAPPING

ALMOND BOARD OF CA DELIVERABLES

- Overall accuracy of about 99% based on independent ground-truth validation dataset for specific crop type
- Mapping completed for 2010, 2012, 2014, 2016, 2018, 2019, 2020, 2021
- April (initial) bearing and removed acres
- November (final) non-bearing, bearing, and removed acres

2021 STANDING ACREAGE - INITIAL ESTIMATE

In cooperation with the Almond Board of California

Released: April 22, 2021

LAND IQ

california almonds
Almond Board of California

RESULTS

Each year Land IQ produces an in-year, statewide almond acreage estimate. The initial bearing acreage estimate is provided in April, with the final estimate, including a non-bearing estimate, provided in November.

The initial bearing acreage estimate is for the 2021 production year (September 1, 2020 - August 31, 2021). Removed orchards have been determined through spatial analysis as of March 31, 2021. Therefore, a numerical estimate of orchards to be removed based on historical analyses and present conditions from April 1, 2021 through August 31, 2021 is also included.

As a result, the 2021 initial estimates are:

- 1,323,722 acres of bearing almonds
- 47,803 acres of removed almonds

These values will be updated for the final 2021 total acreage estimate to be delivered in November 2021. It should be noted that bearing acreage may be adjusted slightly (+/- 1-3%) following summer 2021 ground truthing verification. Any change will mostly likely affect acreage transitioning from non-bearing in 2020 to bearing in 2021, thus the impact on estimates of overall production volume should be considered negligible.

The following table represents removals and bearing acreage by County for 2021. Acreage by year planted and removals by year planted are provided on the following pages.

INTRODUCTION

Beginning in 2019, the ABC began an annual mapping process with two acreage summaries, one delivered in April and one delivered in November, during the same production year. The Land IQ April delivery informs and aligns with the United States Department of Agriculture (USDA) – National Agricultural Statistics Service (NASS) California Almond Forecast, which is an initial subjective forecast for acreage and yield.

APPROACH

Land IQ draws upon on multiple lines of evidence including agronomic and remote sensing knowledge, unique field boundaries, robust on-the-ground verification, customized image analysis, artificial intelligence and machine learning algorithms to classify almond orchards.

For each mapped year, Land IQ performs the following steps:

1. Imagery Acquisition
2. Irrigated Field Boundary Delineation
3. Ground Truthing
4. Remote Sensing Analysis
5. Change Analysis and Update

For the initial estimate determining removals and bearing acreage, Land IQ utilizes the spatial mapping from 2020, in addition to a change analysis to determine removals.

County	Bearing Acreage	Removed Acreage	County	Bearing Acreage	Removed Acreage
Alameda	688	0	Placer	2,145	0
Butte	33,037	798	Riverside	6	0
Calaveras	197	0	Sacramento	1,979	0
Colusa	59,039	1,849	San Joaquin	76,402	1,687
Contra Costa	315	0	San Luis Obispo	2,213	0
Fresno	252,665	7,515	Shasta	5	0
Glenn	48,786	3,711	Solano	19,607	30
Kern	196,373	10,327	Stanislaus	171,773	5,302
Kings	34,368	517	Sutter	12,129	173
Lake	37	0	Tehama	17,082	315
Madera	142,712	5,119	Tulare	71,388	1,806
Mariposa	4	0	Yolo	39,150	478
Merced	136,152	4,673	Yuba	1,971	5

2020 L Street, Ste 210
Sacramento, CA 95811
www.LandIQ.com - (916) 265-6330

2021 Standing Acreage - Initial Estimate - April 15, 2021

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013							
Alameda																																					37
Butte	6,648	52	202	261	143	182	351	192	490	589	201	577	135	610	1,083	570	573	364	621	559	1,294	1,140	680	799	3,618	1,288	1,218	641	435	586							142,712
Calaveras	12									5																											4
Colusa	743	10	50	54	54	56	432	104	101	326	615	631	487	1,846	1,062	2,238	1,343	1,594	1,142	2,155	5,364	3,700	3,559	2,087	3,138	2,512	2,074	2,058	1,219	1,887							136,152
Contra Costa	3																	2																			2,145
Fresno	270	74		1	85	157	633	163	504	343	447	488	856	2,885	2,820	4,173	5,561	4,196	6,648	6,397	12,296	15,958	16,914	11,571	6,549	5,544	5,729	8,472	9,294	12,280							6
Glenn	1,132	47	58	77	85	286	223	178	265	545	480	368	513	1,294	764	1,317	517	1,071	562	1,597	1,945	2,490	1,755	1,737	5,189	1,137	610	2,215	1,599	1,905							1,979
Kern	347	35		125	249	57	287	175	254	294	217	1,286	1,625	3,872	4,351	2,122	2,072	3,275	6,362	14,008	19,131	16,862	8,226	5,445	5,793	4,606	8,921	6,436	8,854							76,402
Kings								2						242	727	393	288	299	1,272	136	1,191	1,567	1,487	1,121	791	823	768	404	1,448	2,209							2,213
Lake							12			26																											5
Madera	1,792	9	190	123	127	255	251	105	121	803	1,047	757	1,192	2,489	1,359	1,135	2,253	1,395	2,270	4,071	6,354	6,650	8,529	7,718	11,543	5,778	2,919	9,129	4,651	7,730	12,093	7,742	11,336	11,625	7,169		37
Mariposa																											4										142,712
Merced	7,982	291	142	386	489	617	1,053	658	1,010	1,982	1,091	1,220	2,747	2,717	1,779	2,546	2,117	2,326	2,121	3,090	6,960	6,722	6,396	8,336	2,686	3,145	2,602	3,384	3,487	4,911	10,620	7,319	11,305	8,309	13,607		4
Placer	43									337																					21		1,032		713		136,152
Riverside																							6														2,145
Sacramento	8									2					2									95	14						68	185	750	172	684		6
San Joaquin	4,880	219	83	153	261	291	326	155	290	568	210	399	1,164	813	984	1,427	1,147	1,334	1,196	1,391	2,613	2,276	1,898	2,131	1,765	1,194	1,328	2,999	3,131	4,042	7,293	4,439	7,721	7,121	9,158		1,979
San Luis Obispo	75	19	21	24	9	31	59	6	45	12	1,723	138	3							9	2			5			1				31						76,402
Shasta										2					3																						2,213
Solano	227		36		49	8	43	6	53	87	31	117		5	229	87	114	146	70	148	153	476	361	112	65	121	41	128	13	181	2,657	4,872	4,551	2,536	1,884		5
Stanislaus	10,549	305	347	539	720	302	921	836	735	1,500	2,155	1,636	1,960	2,606	4,081	3,271	3,196	1,739	3,459	3,121	10,664	7,620	6,431	7,038	5,914	5,063	3,538	8,515	6,778	9,875	12,602	9,178	12,477	9,272	12,832		19,607
Sutter	428	36	2	51	42	36	150	56	71	43	242	51	80	603	172	186	74	114		272	765	201	611	641	218	435	156	390	60	366	380	418	2,526	399	1,854		171,773
Tehama	582	7	23			11	21	26			47	66	180	344	121	146	346	301	299	239	590	269	513	1,157	1,407	341	109	327	510	1,211	1,438	655	3,506	772	1,518		12,129
Tulare	187						3	78	75	208	152	215	200	354	503	758	374	194	567	1,156	2,290	2,326	3,460	2,722	1,668	2,348	2,361	3,073	1,964	1,080	7,995	7,678	11,765	5,407	10,228		17,082
Yolo	129		1		30	16	281	1	76	352	94	173	243	459	251	537	200	285	175	749	1,436	1,480	1,809	1,232	1,248	1,962	486	1,809	537	2,657	3,990	4,203	5,452	3,909	2,887		71,388
Yuba	25							4		24	2			138		48	47				105	47	214	37	9		7	31		224	164	216	345	40	245		39,150
Grand Total	36,063	1,105	1,156	1,668	2,219	2,497	4,815	2,855	4,012	8,008	8,833	7,052	11,047	19,030	19,811	23,183	20,270	17,434	23,677	31,451	68,030	72,053	71,484	56,766	51,265	37,485	28,556	52,495	41,562	59,998	93,468	87,673	138,722	97,871	123,609	-	1,971
																																					1,327,222
																																	Estimated Removals 4/1-8/31			3,500
																																	Total Estimated Bearing Acreage			**1,323,722**

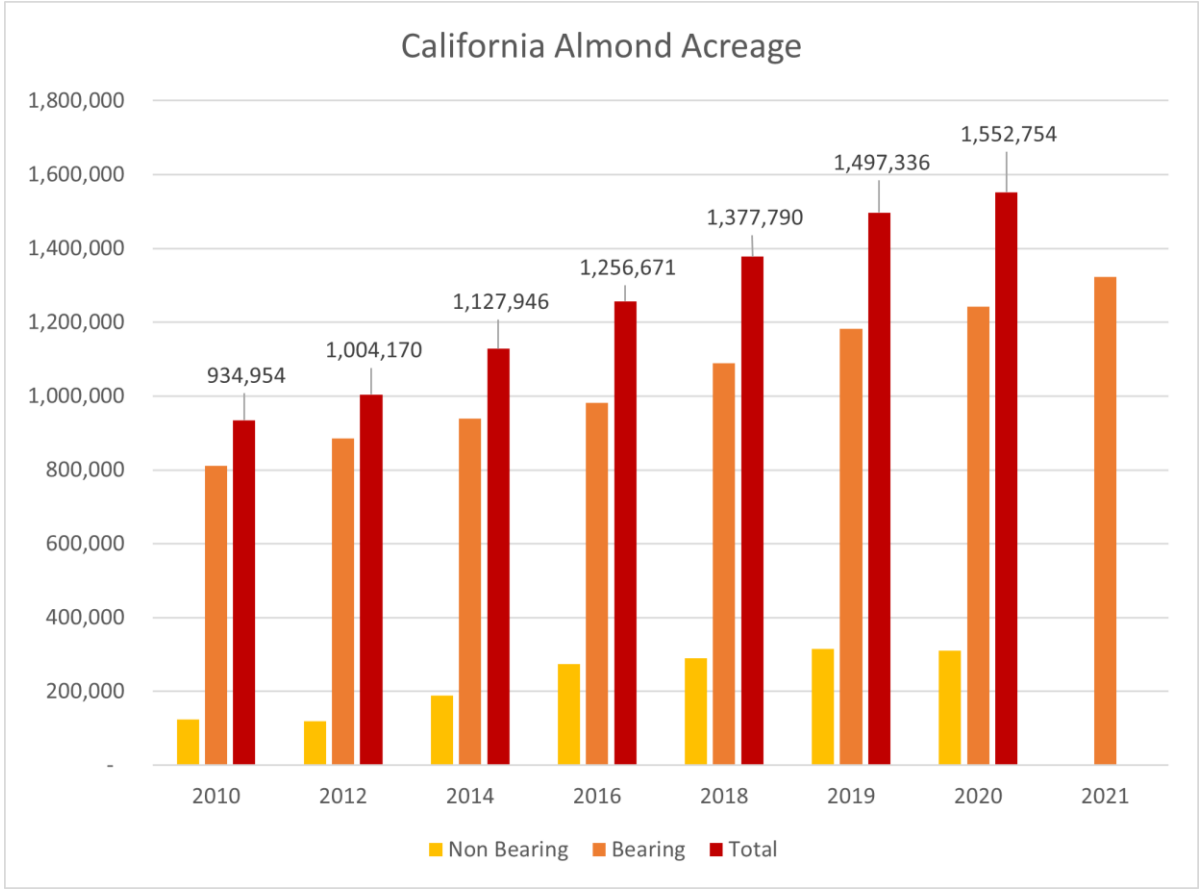
Source: Land IQ, California Statewide Almond Mapping - 2021. Based on data from USDA National Agricultural Imaging Program (NAIP), USGS Landsat, and other private imagery resources.

* 2018 Bearing Acreage will be finalized in November. An estimate of additional acreage has been added to the total, but not to each county.

** A non-bearing estimate will be provided in November.

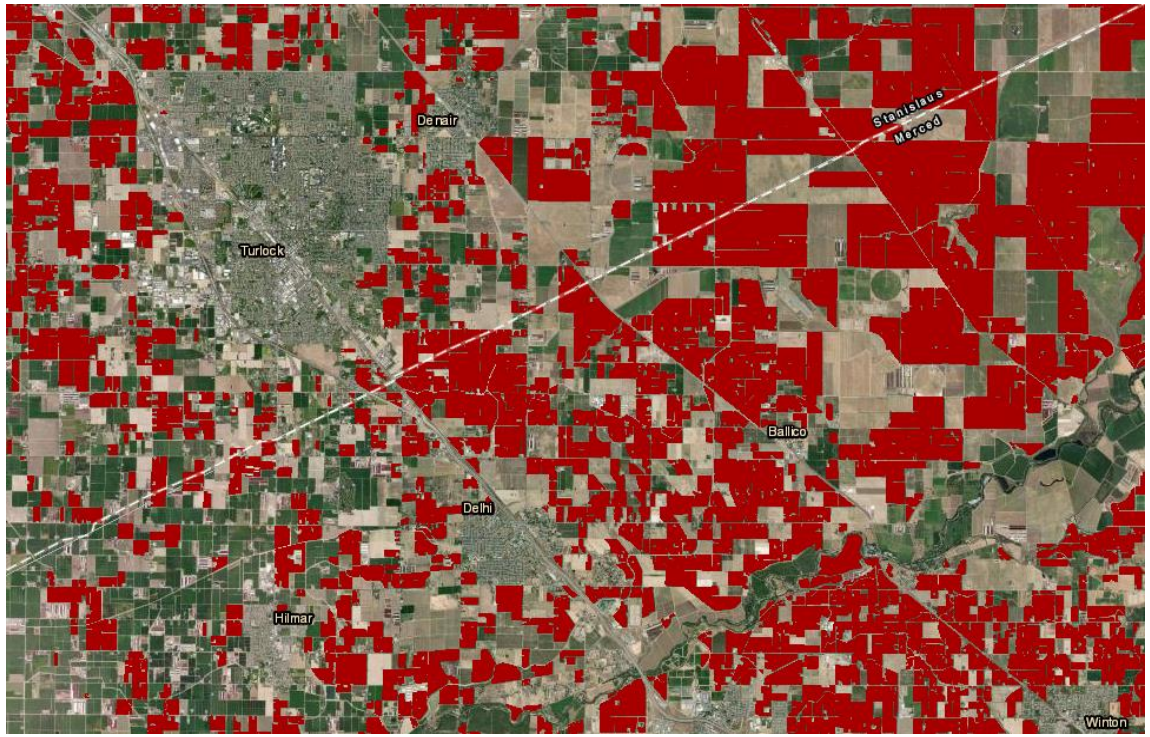
ALMOND ACREAGE BY YEAR

- Land IQ mapping acreage
- Helped USDA NASS readjust their estimates
- Steady increase over time
- Flattening of non-bearing?
- Increase of removals?
- Find the information!



LAND IQ

Almond Mapping - Examples

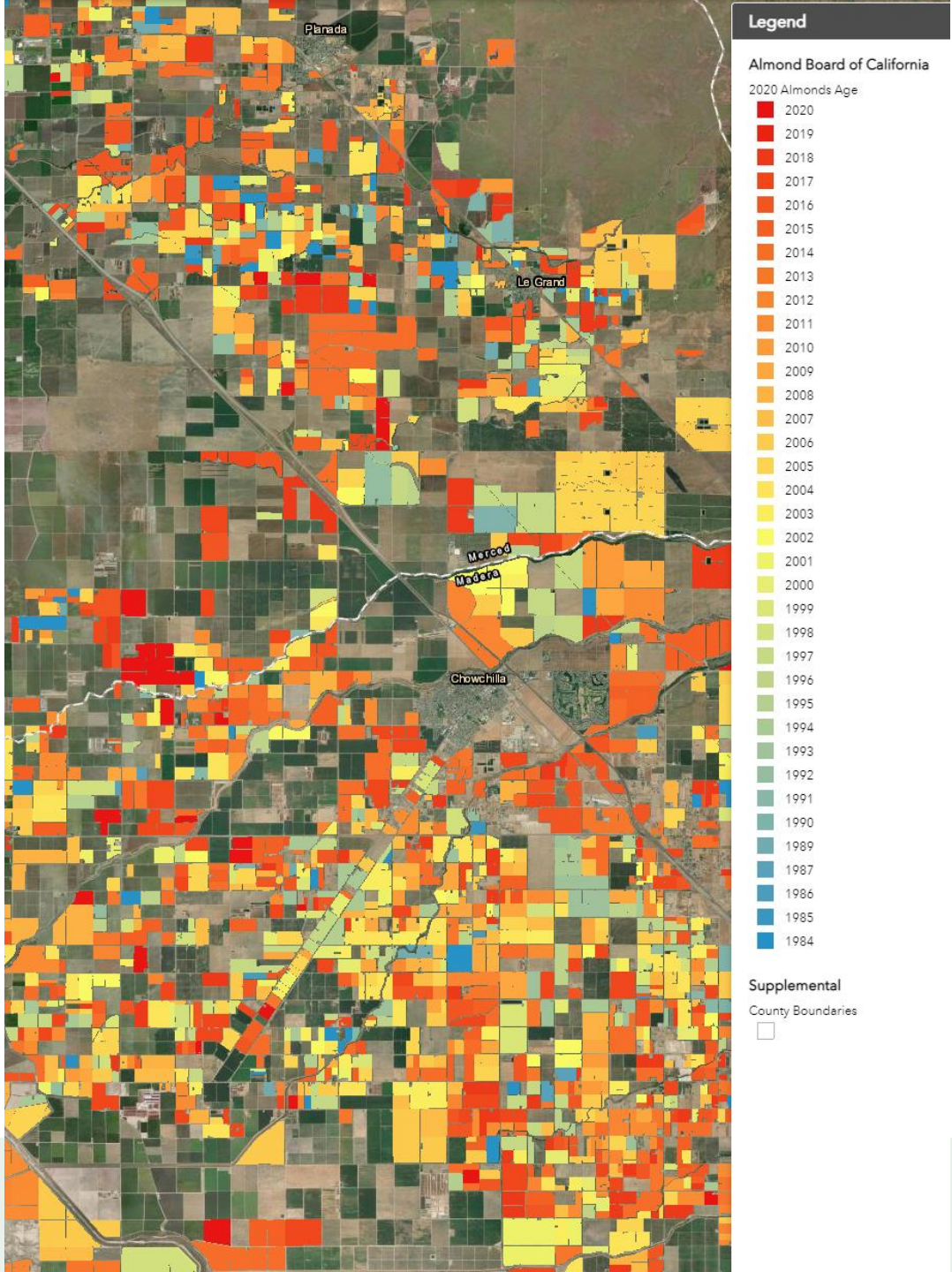


- Variety of uses:
  - Water management
  - Regulatory compliance
  - Real estate understanding
  - Production planning
  - Proximity to other crops/areas

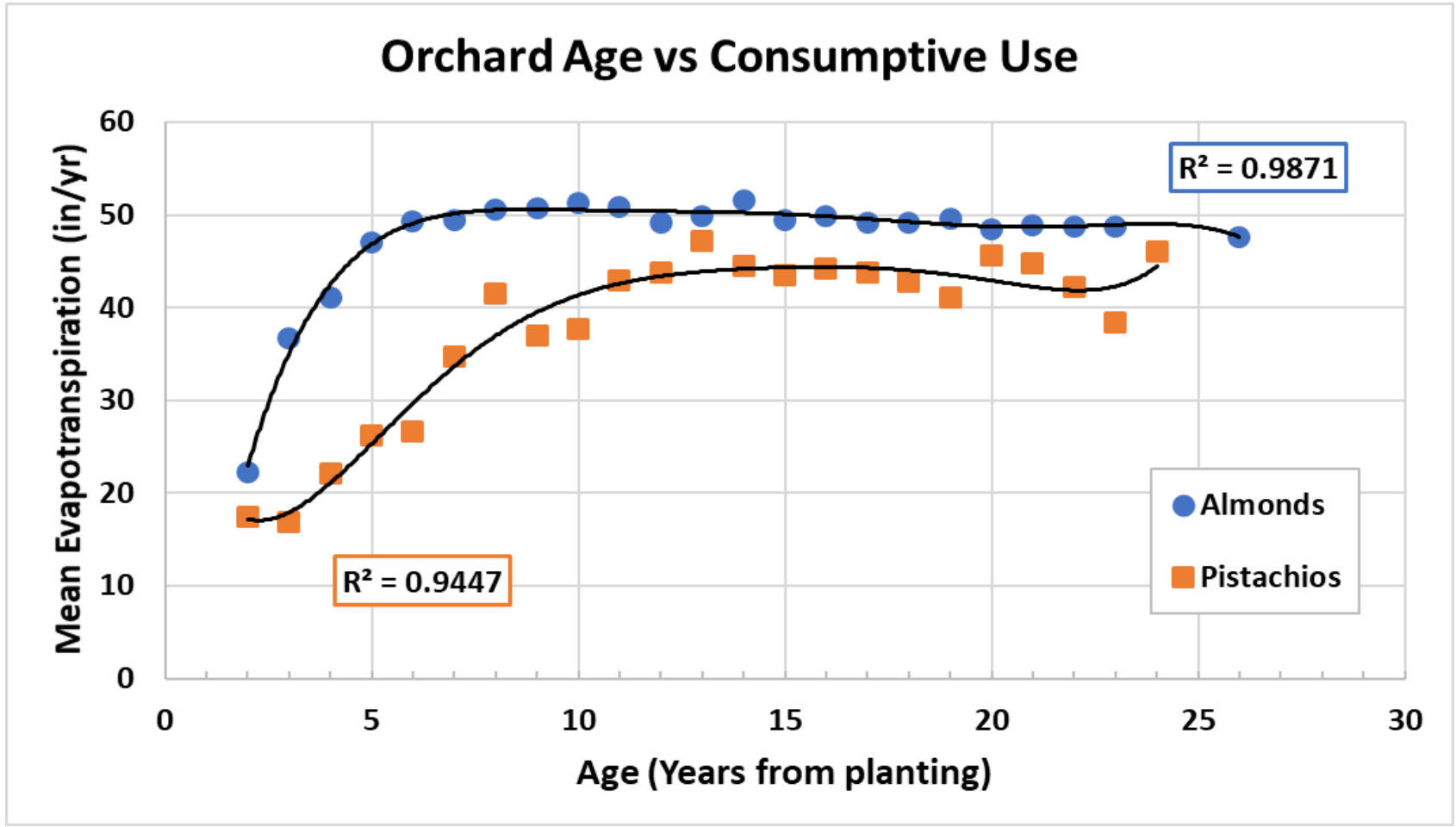
- Mapping characteristics:
  - Minimum field size of 2.0 acres – many times less
  - Overall accuracy for almonds is about 99%
  - The irrigated footprint of the orchard only – not parcel boundary

APPLICATION - ALMOND AGE

- Stated back in 2011
- Land IQ was doing some other “spatial” work for the ABC
- During a time of rapid almond acreage growth
- Growers on the Board of the ABC suspected acreage was too low
- “I think I’m a good farmer, but I can’t even achieve reported average yields.” (pounds/acre)



APPLICATION – ALMOND WATER USE

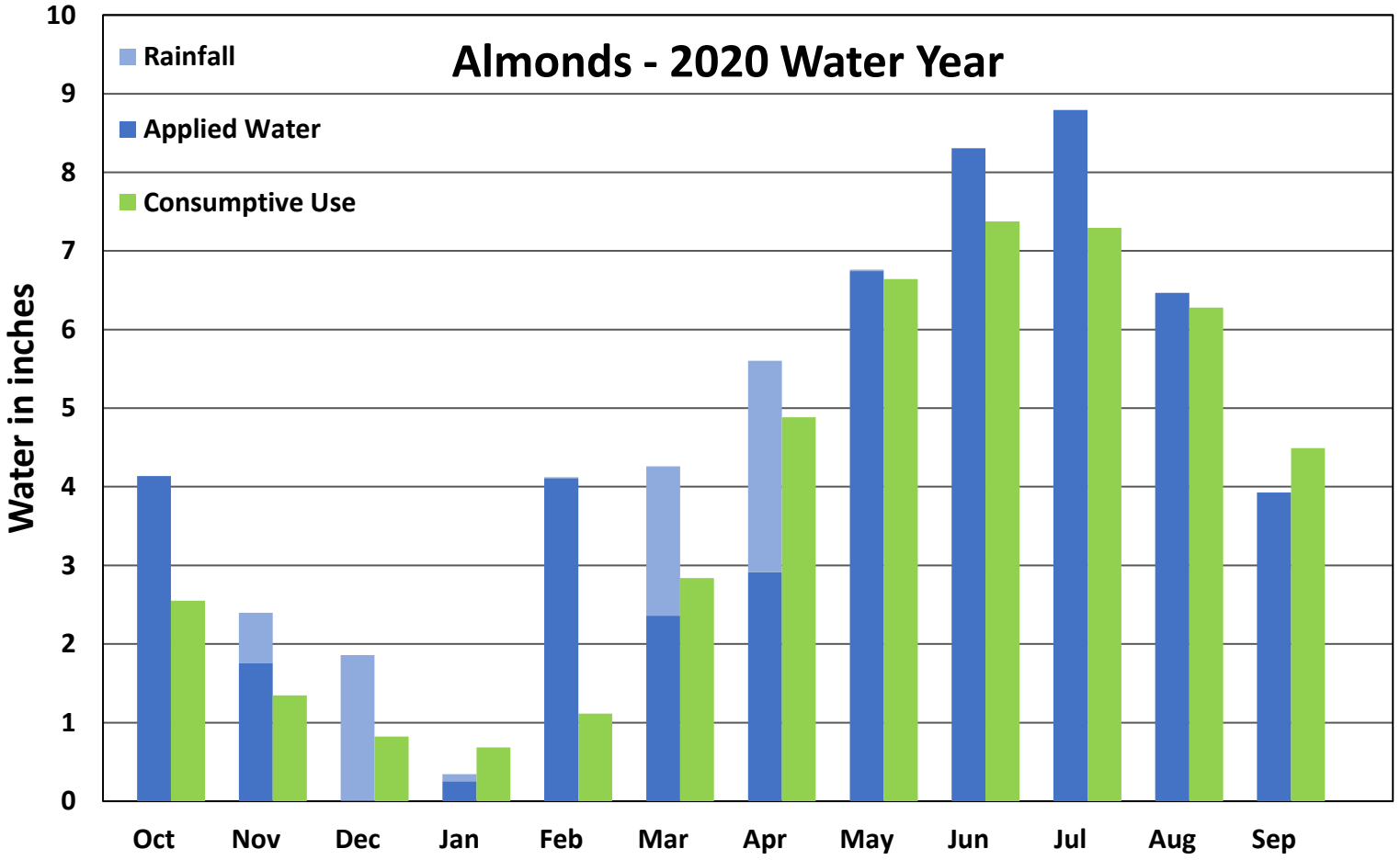


Orchard age versus consumptive use in for all almond and pistachio orchards in multiple GSAs.

The analysis starts at year two to ensure that fields were not partially planted.

APPLICATION – ALMOND WATER USE

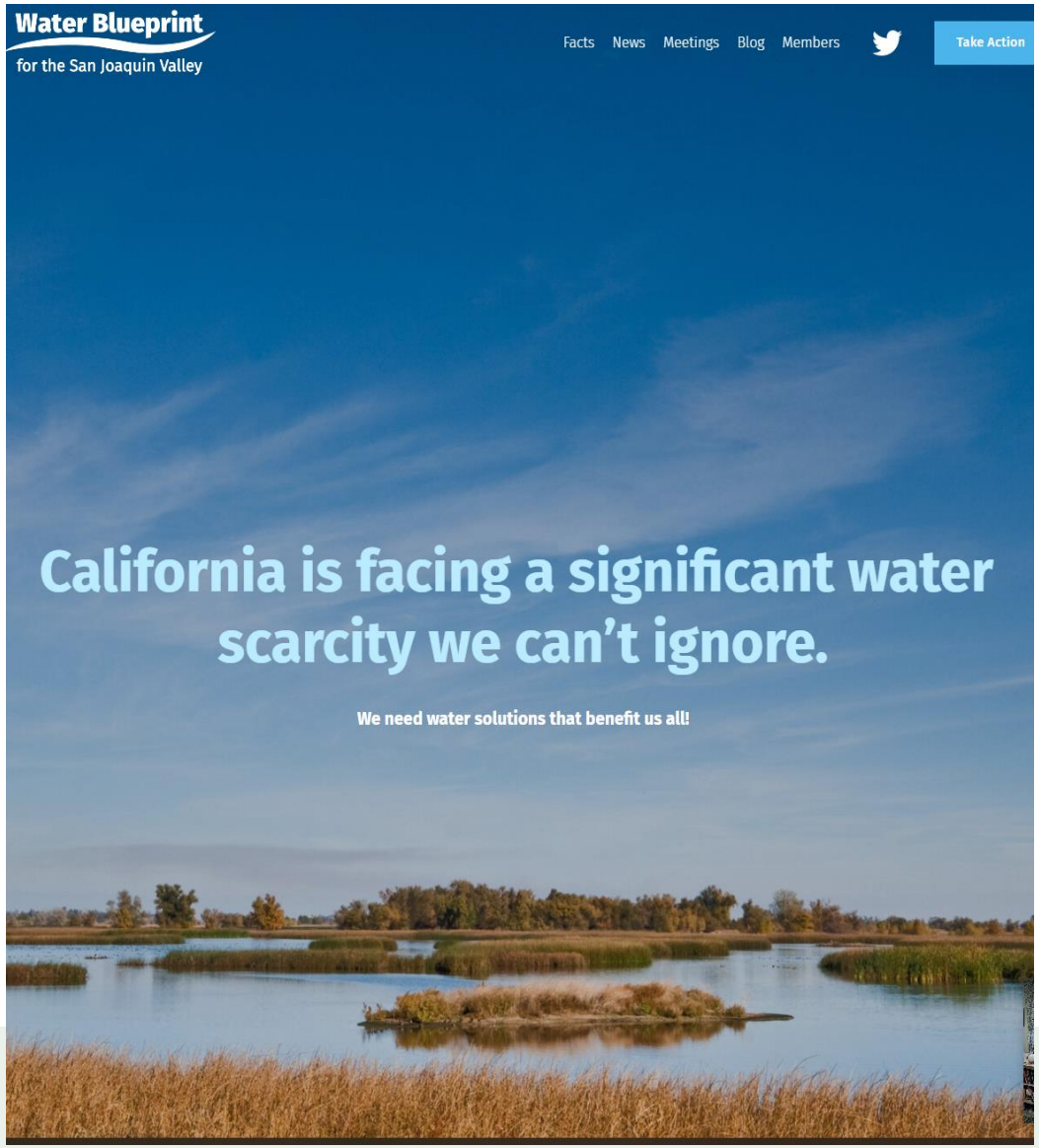
- Understanding of on-the-ground agronomics and irrigation management



- Oct - Post harvest irrigation
- Feb - Filling the root zone
- Mar/Apr – Taking advantage of rainfall
- Aug/Sep - Reducing irrigation during harvest

WATER BLUEPRINT FOR THE SAN JOAQUIN VALLEY

- Economic impact study for critically over-drafted groundwater basins
- Critically over-drafted groundwater basins south of Sacramento
- Results:
  - $7.2 billion in annual farm revenue loss
  - 85,000 jobs lost statewide
  - $2.1 billion in annual lost employee compensation statewide
  - Up to 1.0 million acres will likely go fallow in the south valley due to reduced ground- and surface water supplies
  - 4 counties will see the largest losses in employment and compensation
    - Fresno
    - Tulare
    - Kern
    - Kings



ECONOMIC ANALYSIS

- With the implementation of SGMA:
  - Water markets will surface
  - A shift to more permanent crops may occur
  - Resulting in an increased hard water demand

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UC Davis Center for Watershed Sciences
ERA Economics
UC Agricultural Issues Center

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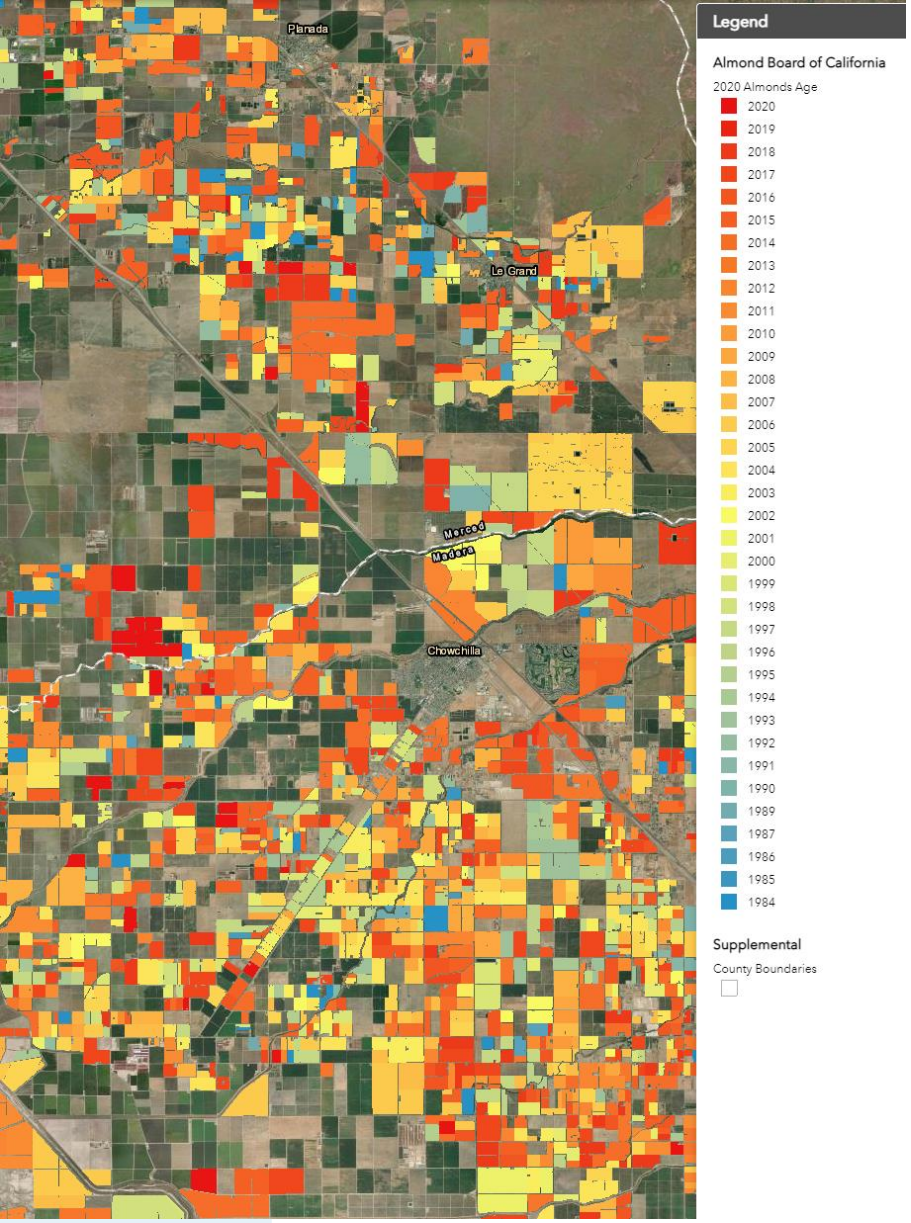
CONCLUSIONS

- Agriculture statewide has never been this dynamic
  - Water quantity issues
  - Water quality issues
  - Regulatory issues
  - Labor issues
  - Trade and economic issues
  - Air quality issues
- SGMA is the biggest game changer
- Almond production has increased steadily for years. Will it continue?



American Society of Farm Managers & Rural Appraisers
CALIFORNIA CHAPTER

MANY THANKS TO THE ASFMRA

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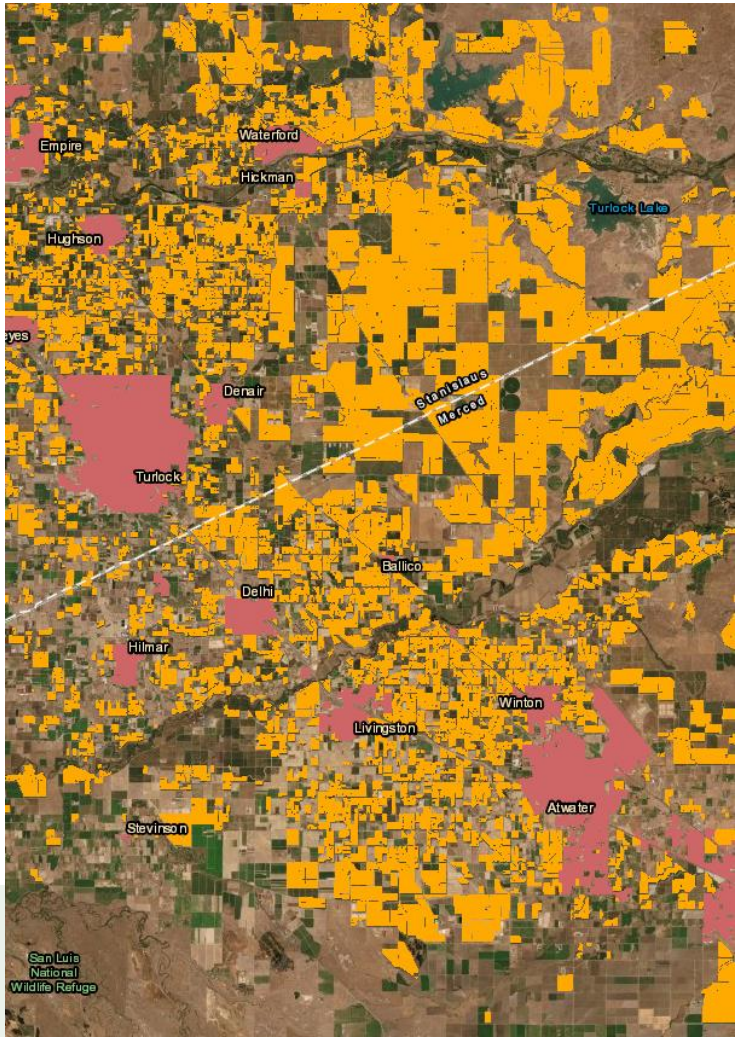

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