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Arizona Water-Use Program

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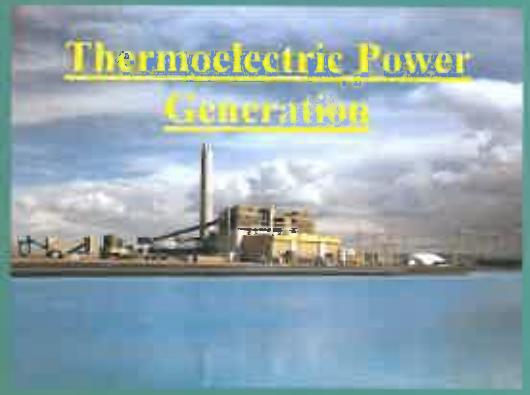
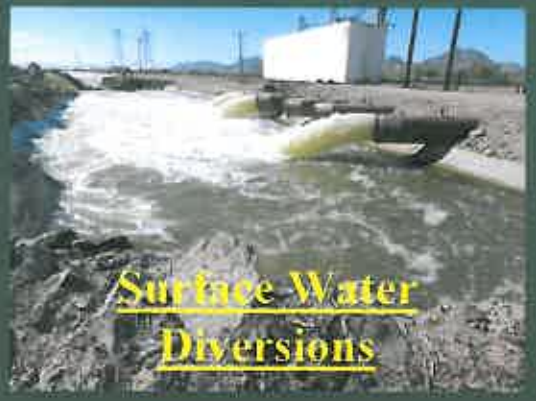
January 11, 2012





Cooperator

- The Arizona Department of Water Resources
- The Arizona Water Science Center is one of the few States in the nation that has an annual water use program

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Program Goals and Objectives

- Document trends in water use (water withdrawals)
- Develop water-use data bases (USGS web access)
- Provide county and basin water-use information to local, state, and federal agencies as well as universities for assessing the effectiveness of water-management policies, regulations, and conservation activities

Need for Data Collection

- The major water issue in Arizona is the relationship between the quantity of water consumed and the long-term dependable supply

Background

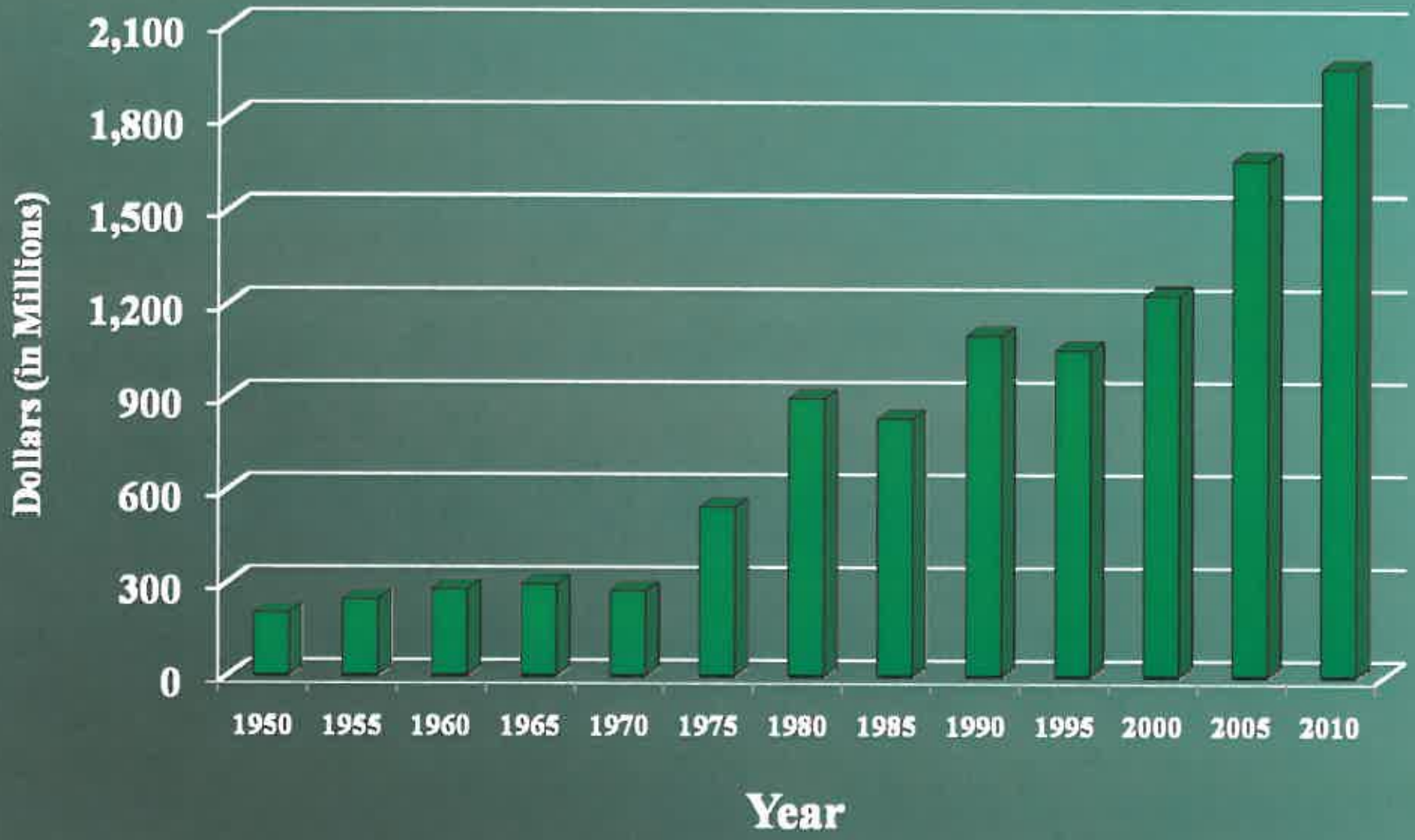
- Because of the predominantly semiarid to arid climate in Arizona, economic development in the State is largely influenced by access to adequate water supplies

- Water demand is met by
  - pumping groundwater from aquifers
  - conveying surface water through reservoirs and canals



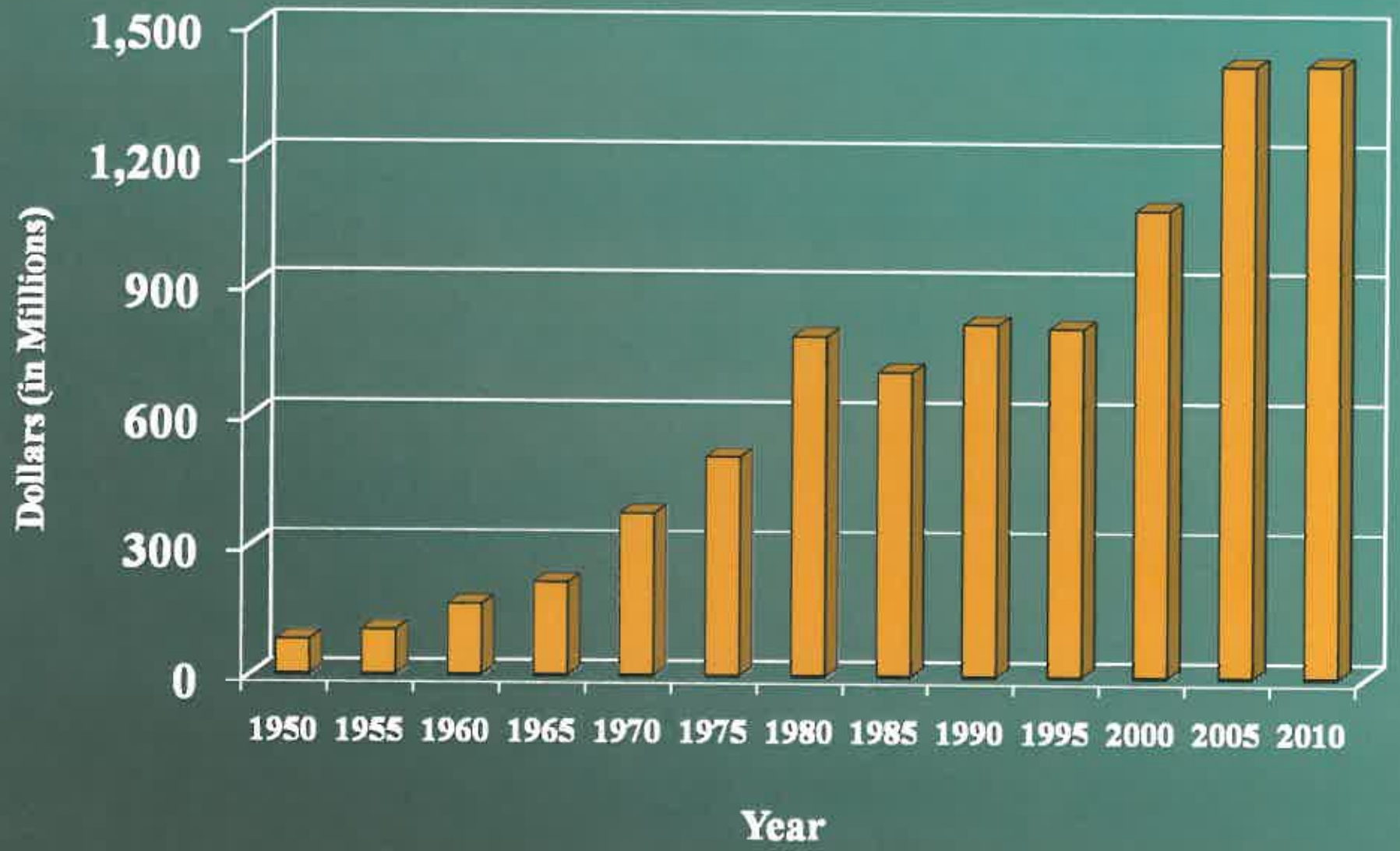

Arizona Cash Receipts from Agriculture, 1950-2010

Sources: Arizona Agriculture and Arizona Agricultural Statistics



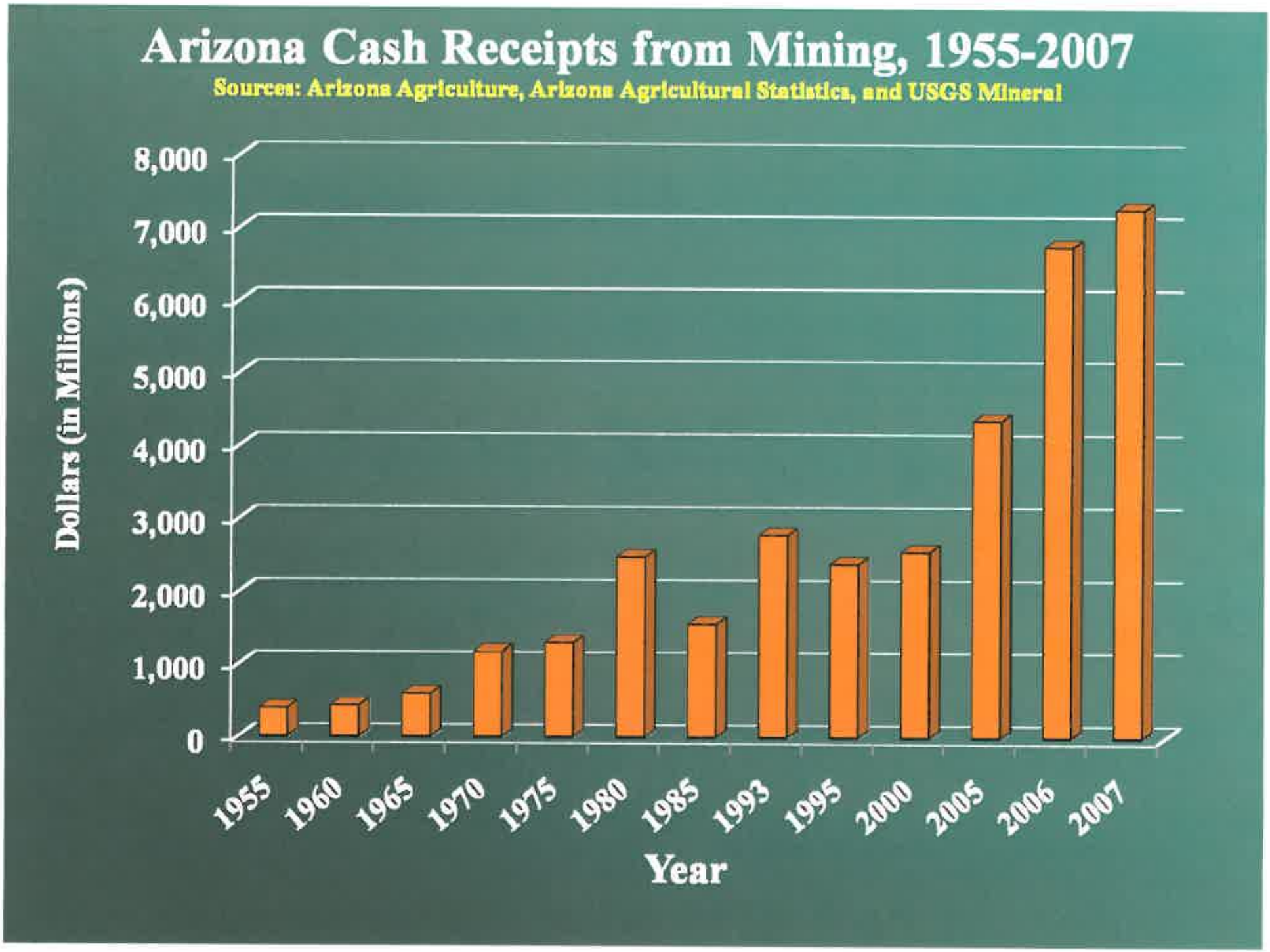
Arizona Cash Receipts from Livestock, 1950-2010

Sources: Arizona Agriculture and Arizona Agricultural Statistics

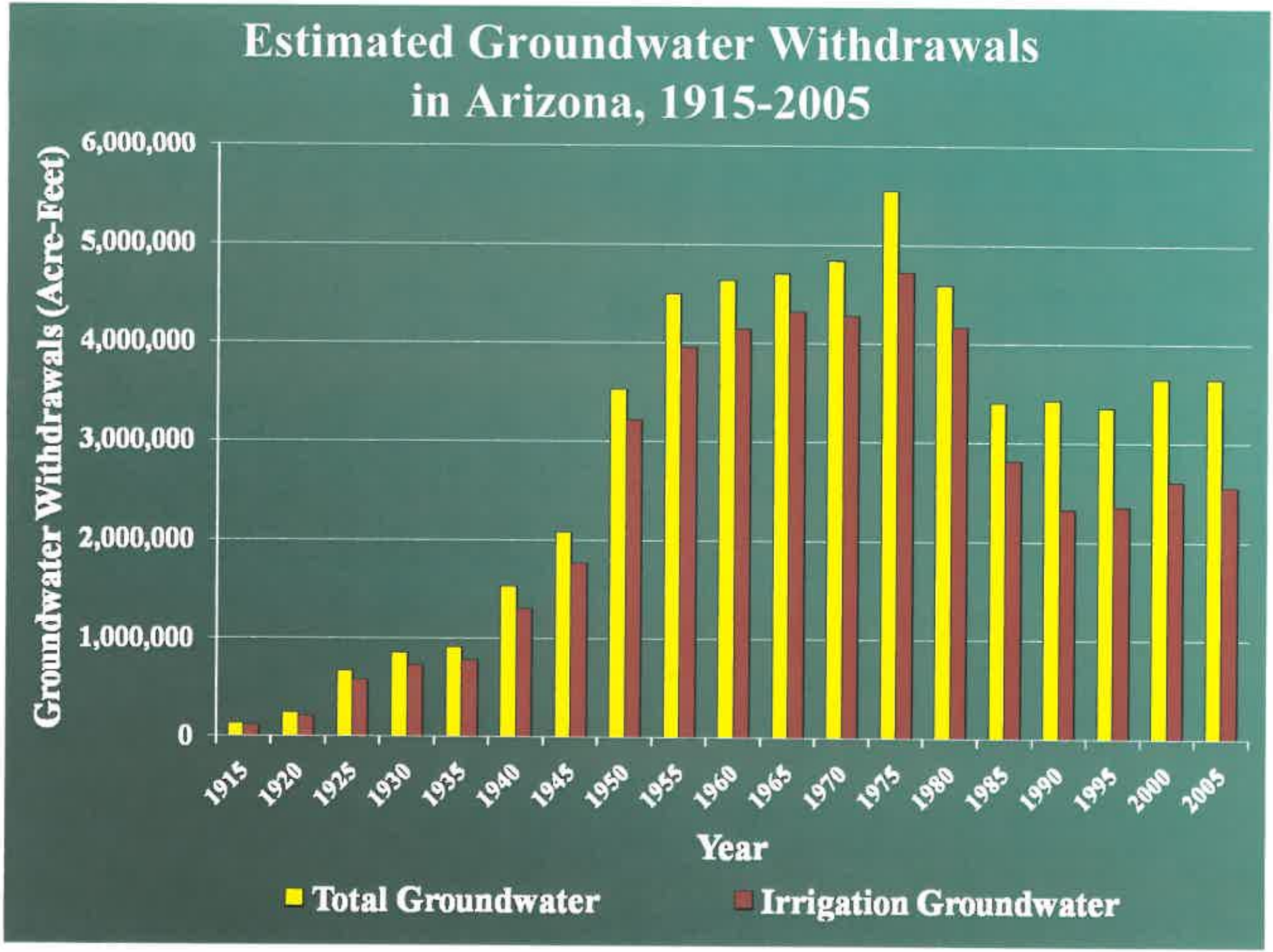


Arizona Cash Receipts from Mining, 1955-2007

Sources: Arizona Agriculture, Arizona Agricultural Statistics, and USGS Mineral



- Water use patterns are dominated primarily by agriculture and a rapidly growing urban population


Estimated Groundwater Withdrawals in Arizona, 1915-2005
Groundwater Withdrawals (Acre-Feet)
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
Total Groundwater
Irrigation Groundwater

5-Year Data Collection by County

- Water withdrawals are collected and estimated by county every five years as part of a National Water-Use Information Program

Irrigation

Municipal

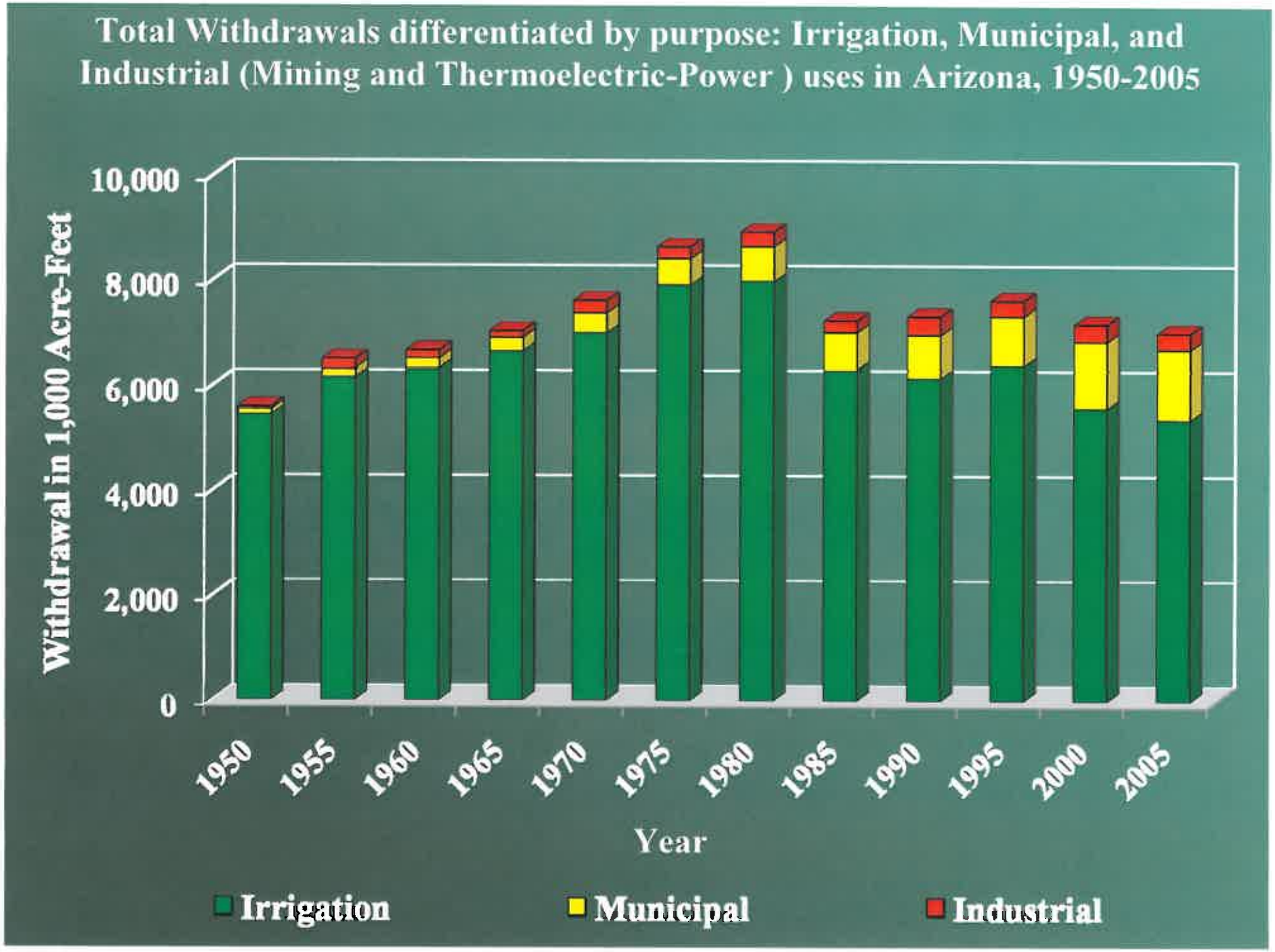
Mining

Thermoelectric Power

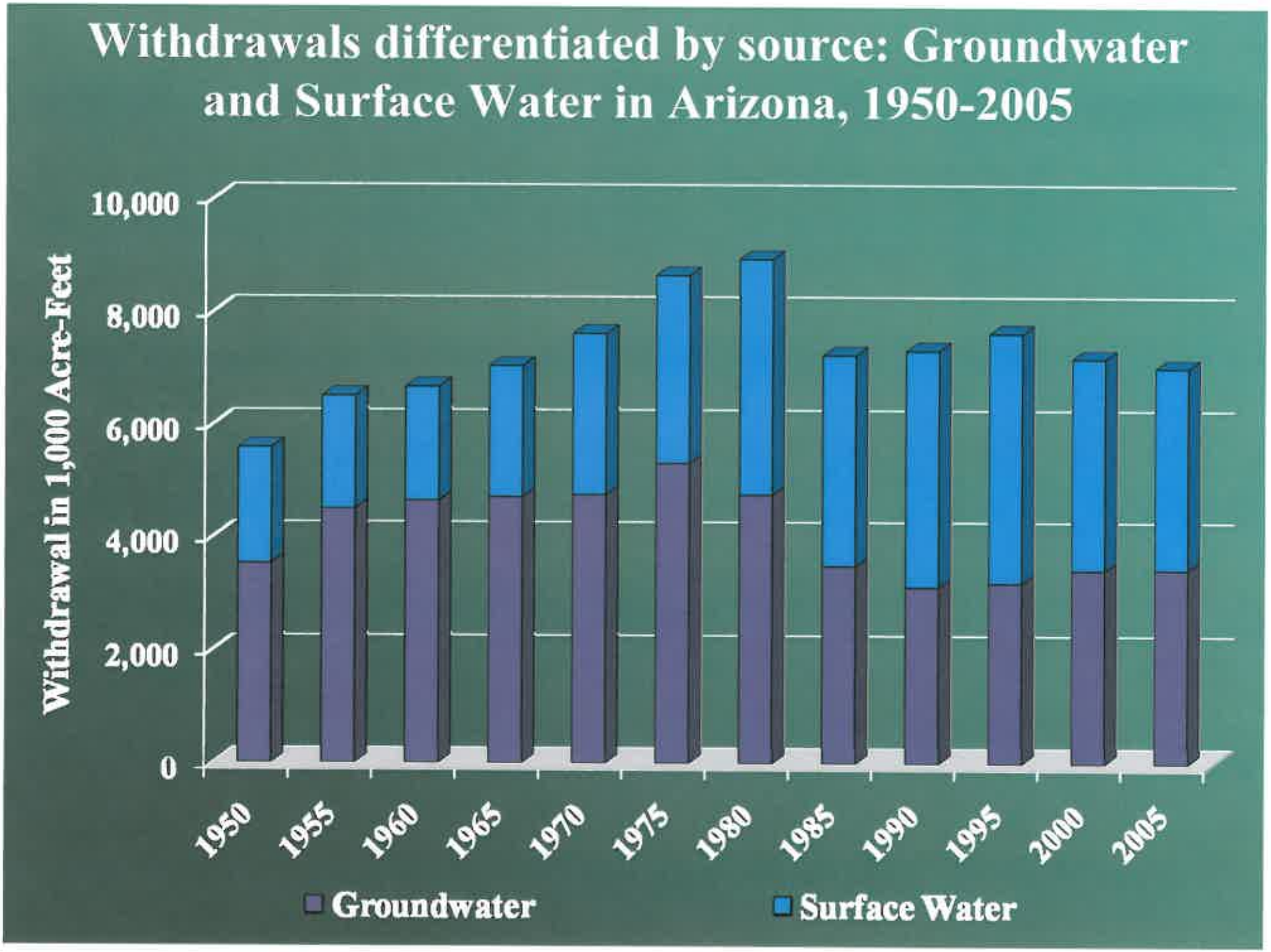
Industrial

Livestock

Aquaculture


Total Withdrawals differentiated by purpose: Irrigation, Municipal, and Industrial (Mining and Thermoelectric-Power) uses in Arizona, 1950-2005
Withdrawal in 1,000 Acre-Feet
10,000
8,000
6,000
4,000
2,000
0
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
Irrigation
Municipal
Industrial

Withdrawals differentiated by source: Groundwater and Surface Water in Arizona, 1950-2005



Estimated Use of Water in the United States

1950 1955 1960 1965 1970 1975

50 years of water use information 1950–2000

1980 1985 1990 1995 2000 2005

Estimated Withdrawals from Principal Aquifers

2000

Data Collection by Basin

- Annual water withdr
  estimated for ADWR

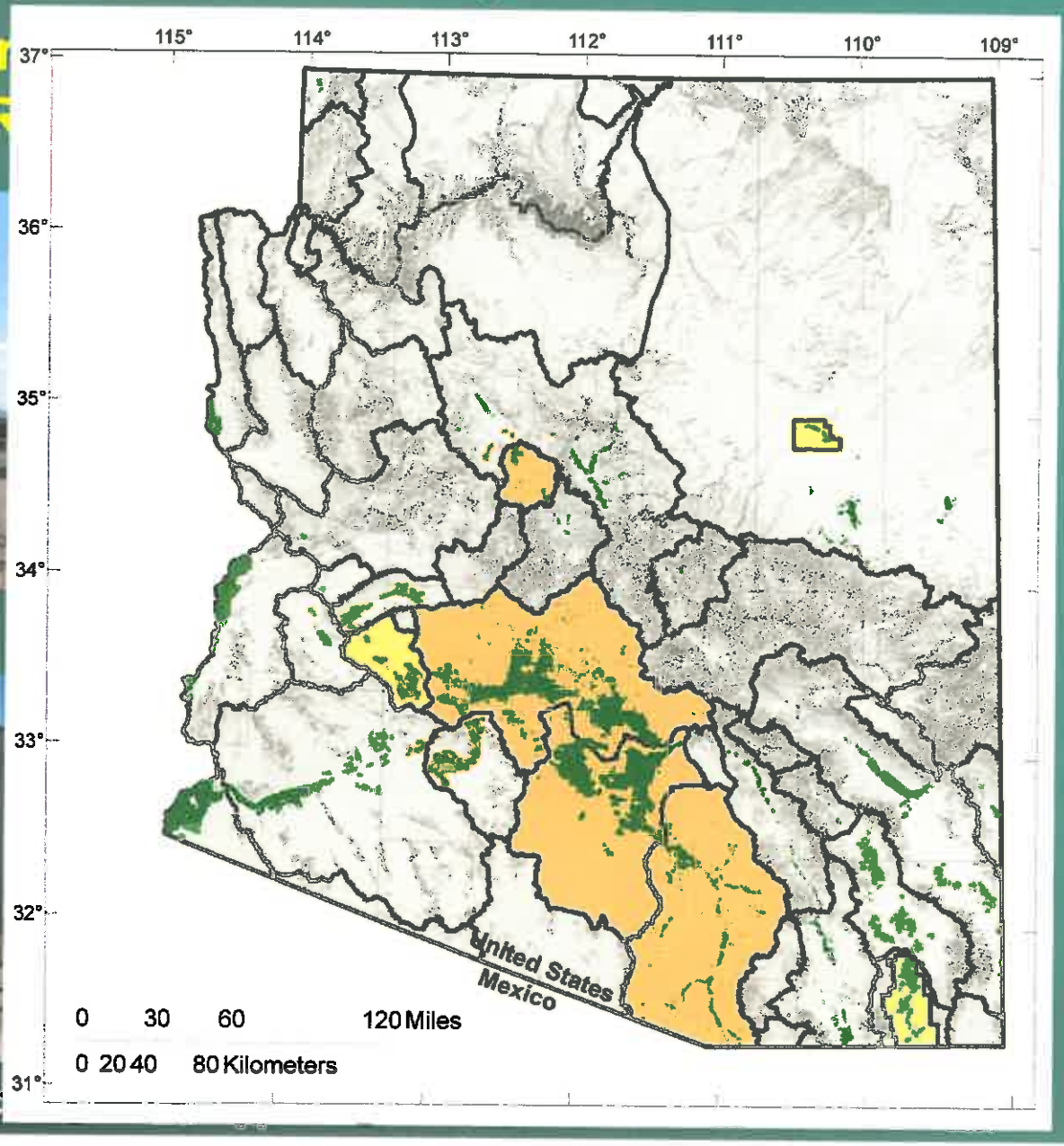
Active Management Area (AMA)

Irrigation Non-expansion Area (INA)

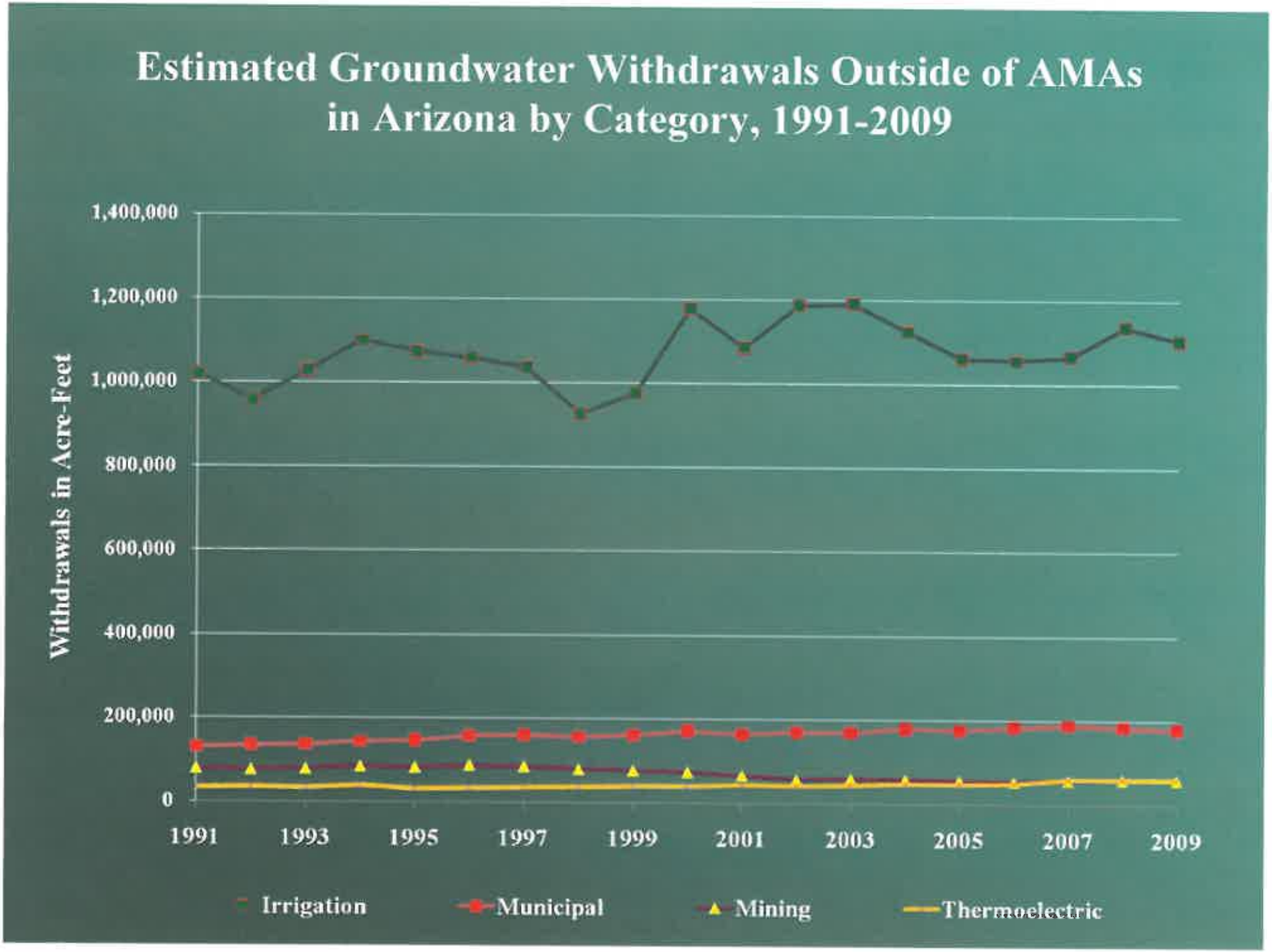
Agricultural Areas

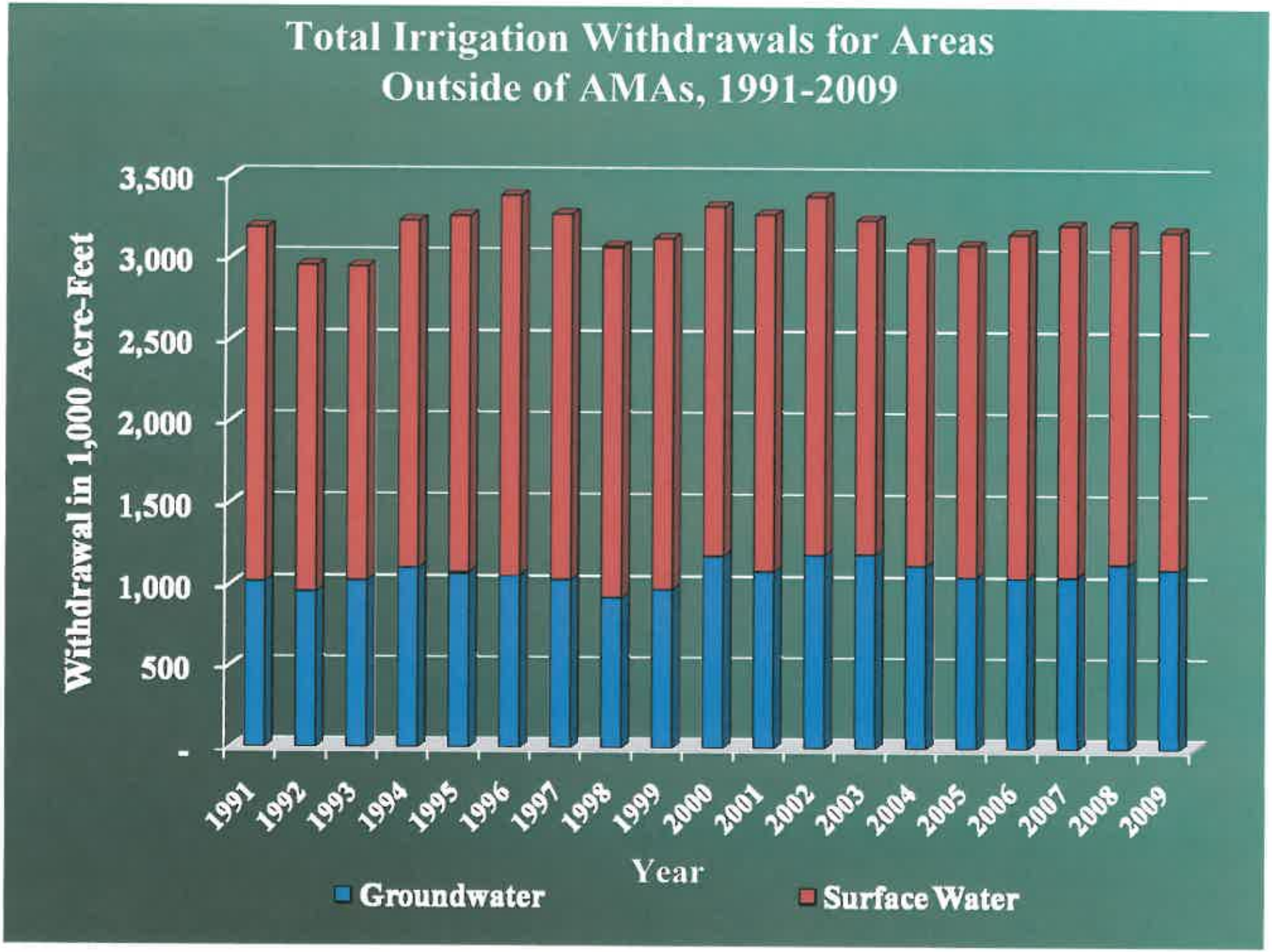
Irrigation

Thermoelectric

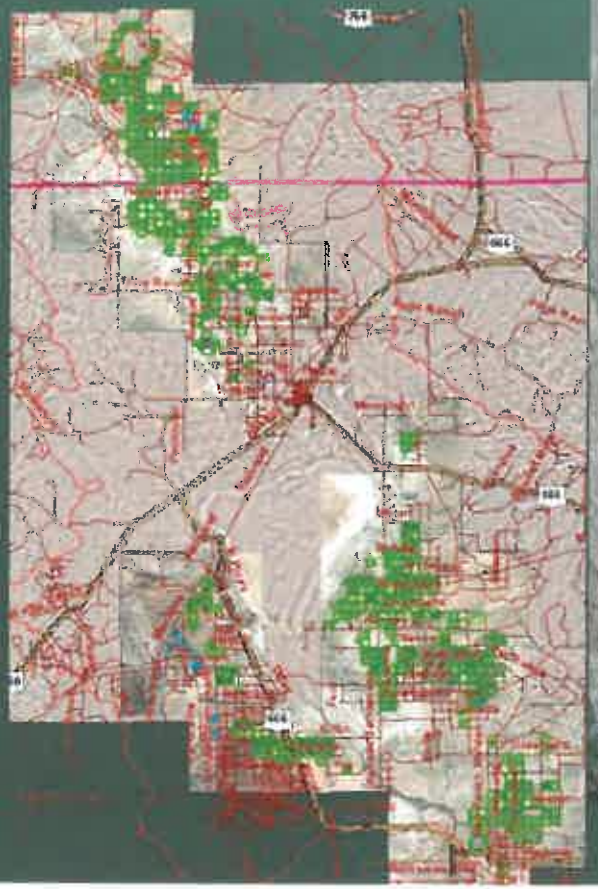


Estimated Groundwater Withdrawals Outside of AMAs in Arizona by Category, 1991-2009




Total Irrigation Withdrawals for Areas Outside of AMAs, 1991-2009
Withdrawal in 1,000 Acre-Feet
3,500
3,000
2,500
2,000
1,500
1,000
500
-
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Year
Groundwater
Surface Water

- Irrigation ground-water withdrawals are estimated using
  - County and basin crop acreage
  - Irrigation-requir
  - Irrigation Efficie



Acres of Cropland Field Verified by the USGS, 2004-2011, by ADWR Groundwater Basin

Consumptive use of water by crop is calculated from the modified Blaney-Criddle method

- Input to the method are:
  - Latitude
  - Average monthly temperature
  - Monthly precipitation
  - Crop type
  - Crop planting and harvesting dates

- Output from the method are:
  - Consumptive water requirement by crop type for each month and total for the growing season


Flood Irrigation
< 50 – 75 Percent Efficient


Center Pivot
70 – 85 Percent Efficient


Surface Drip System
80 – 95 Percent Efficient


Sprinkler System
70 – 85 Percent Efficient

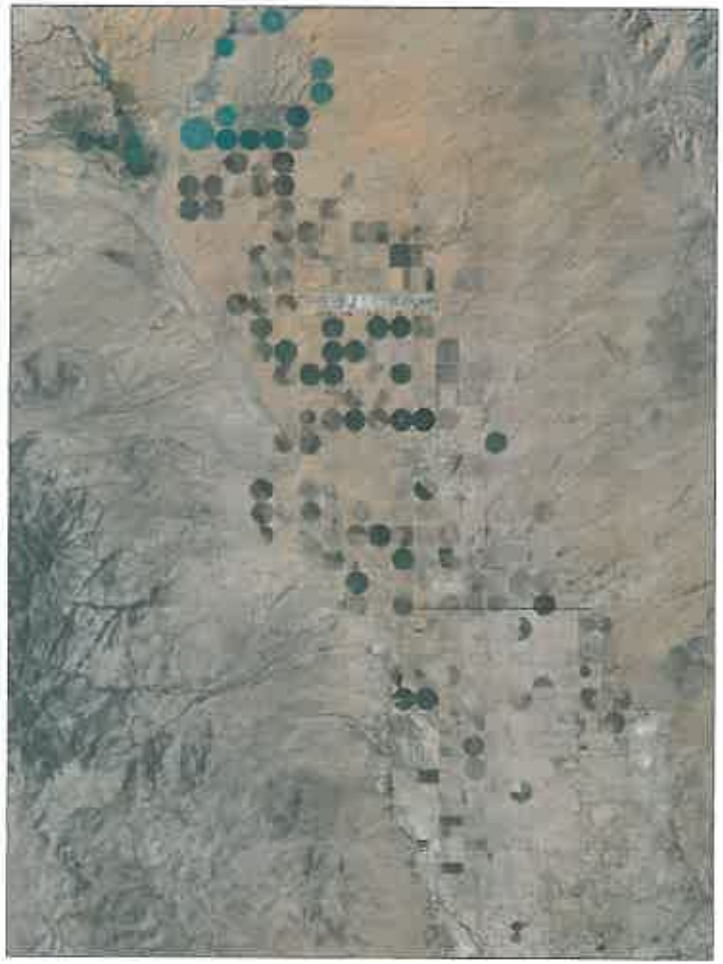
Estimate of Water Withdrawal in a Basin for a Particular Crop

$$W = (A \times C) / E$$

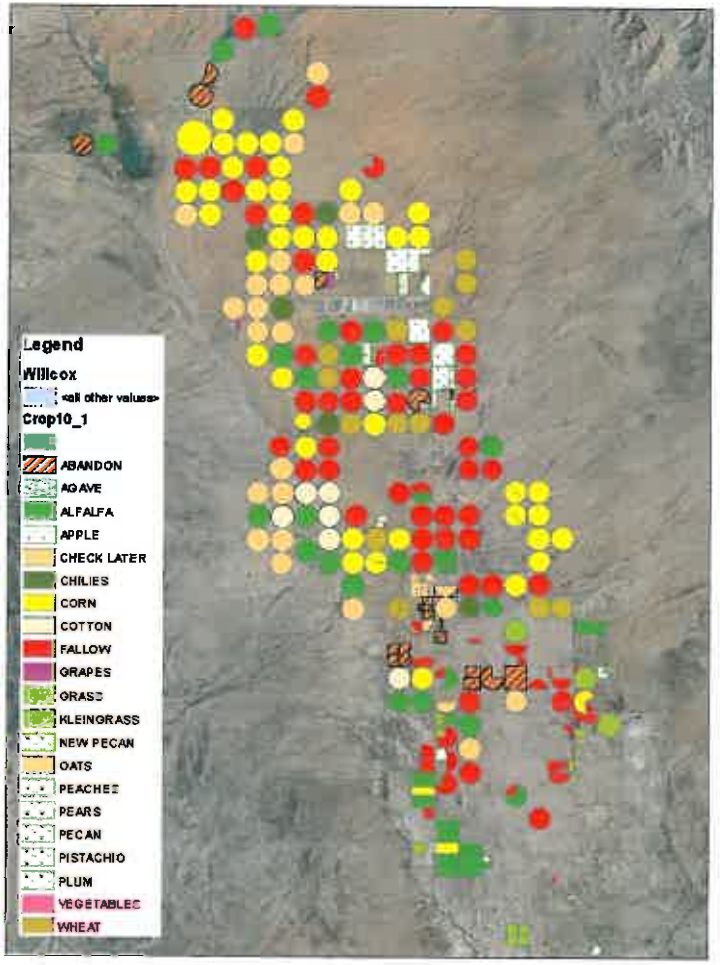
- *A*-planted acreage, for the specific crop, in acres
- *C*-consumptive water requirement for that crop based on the modified Blaney-Criddle method, in feet
- *E*-irrigation system efficiency, in decimal fraction
- *W*-irrigation withdrawal, in acre-feet

All Field Verified Data Stored in ArcMap

2010 Aerial Photographs of the Willcox Basin

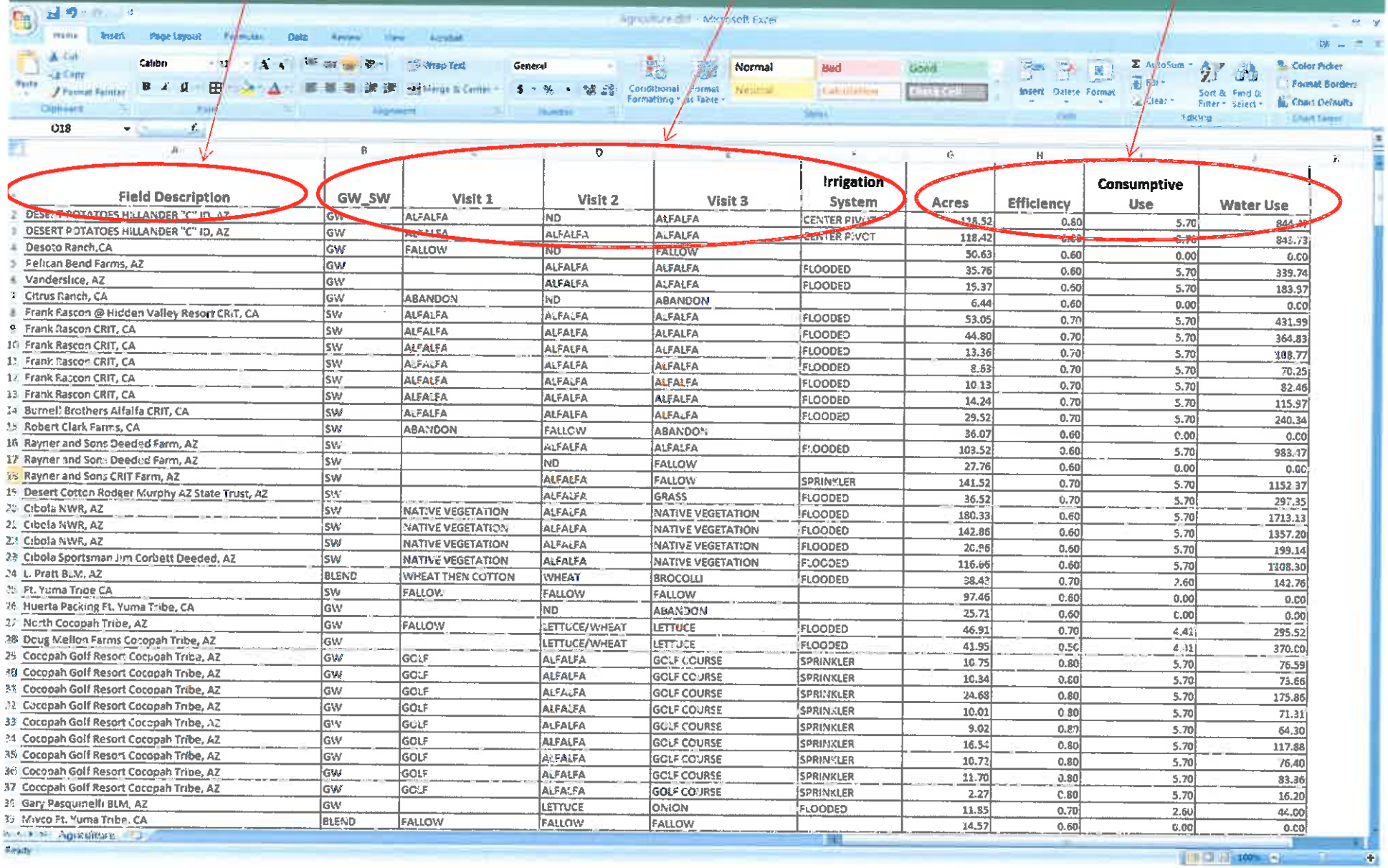


Fields are digitized with crop attributes and polygons are used to calculate crop acreage



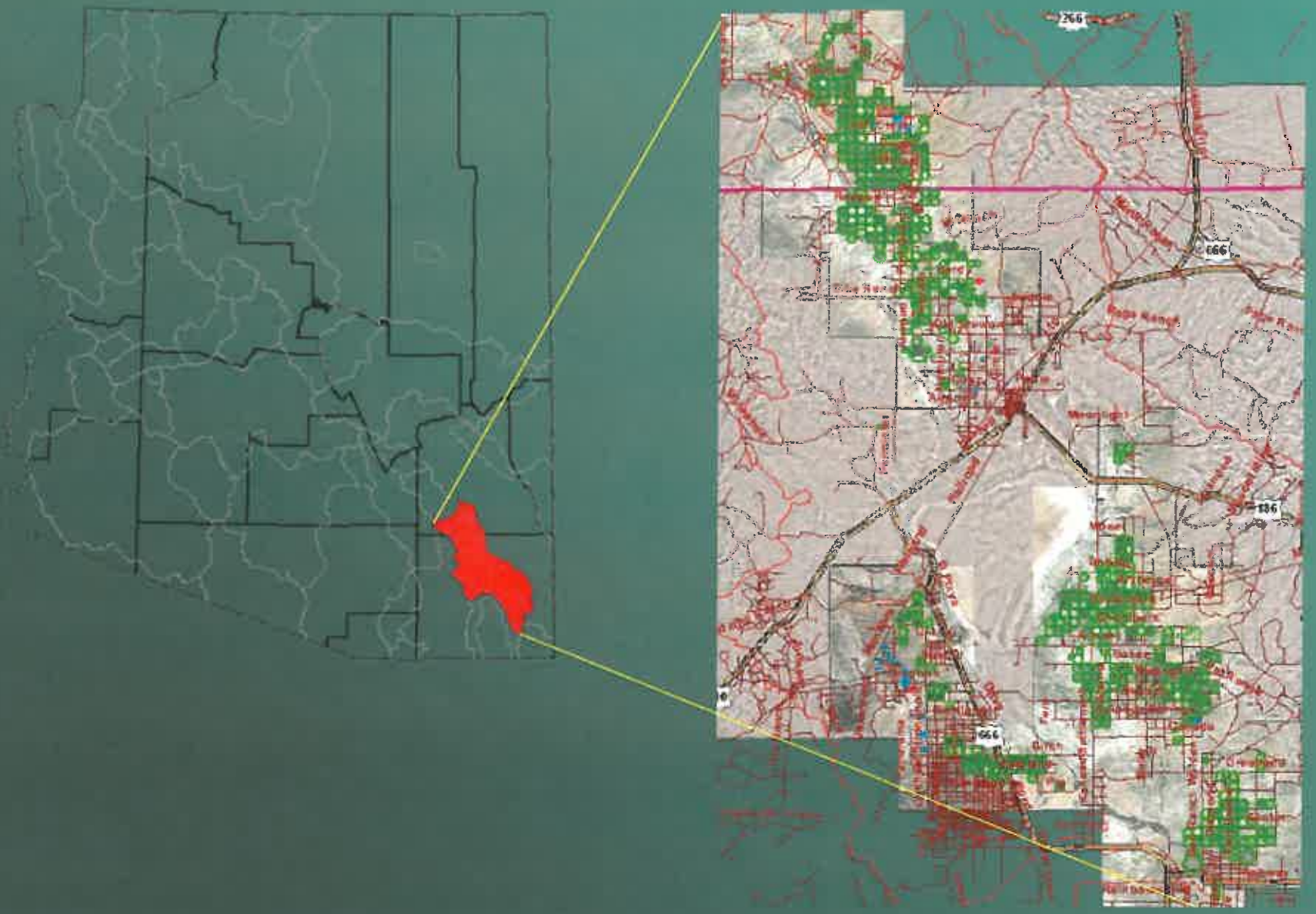
Field Verified Data with Estimated Withdrawals Stored in ArcMap

Field Description **Field Verified Data** **Estimated Withdrawal**

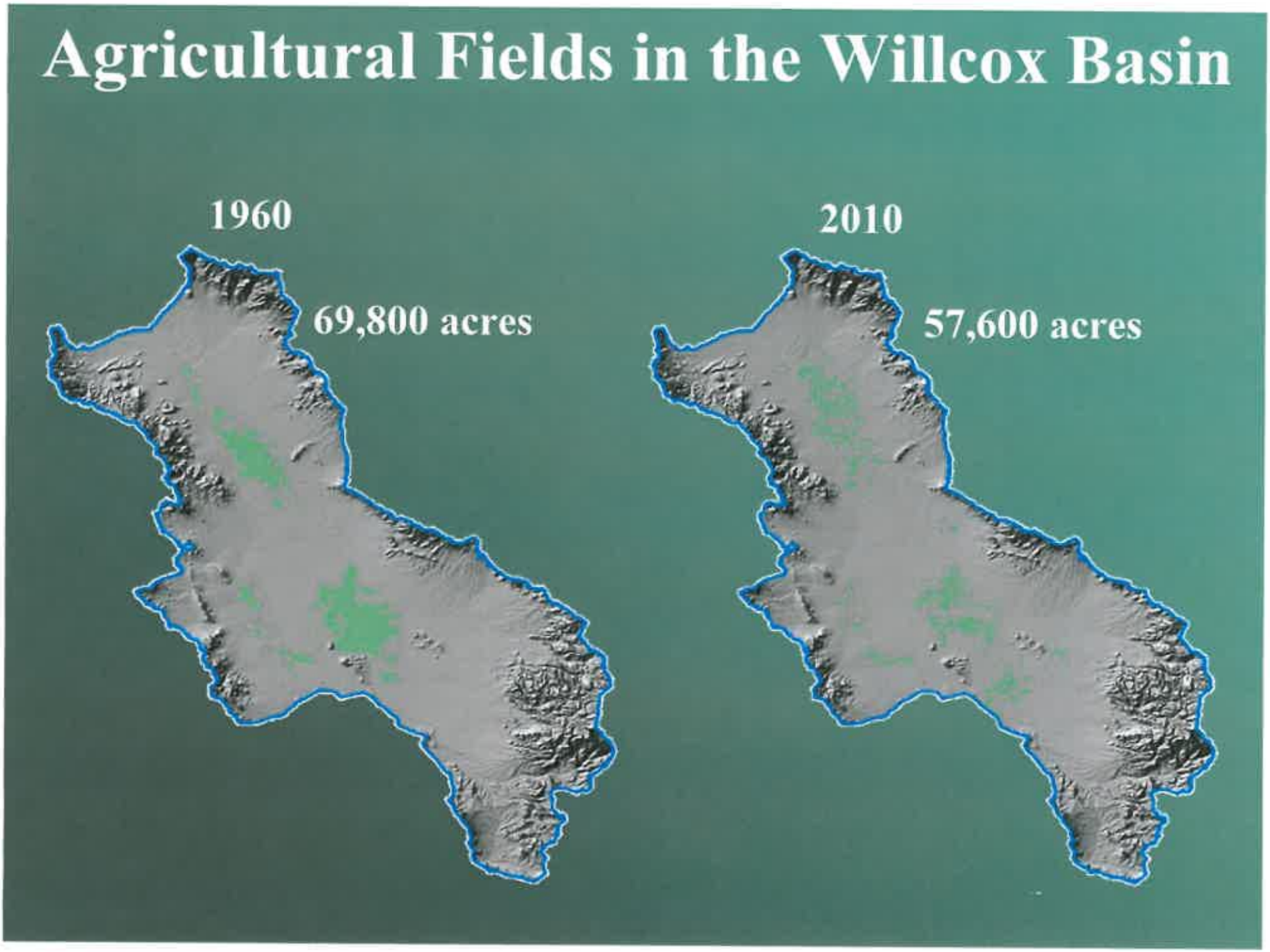


Field Description	GW_SW	Visit 1	Visit 2	Visit 3	Irrigation System	Acres	Efficiency	Consumptive Use	Water Use
DESERT POTATOES HILLANDER "C" ID, AZ	GW	ALFALFA	ND	ALFALFA	CENTER PIVOT	118.52	0.80	5.70	844.47
DESERT POTATOES HILLANDER "C" ID, AZ	GW	ALFALFA	ALFALFA	ALFALFA	CENTER PIVOT	118.42	0.80	5.70	843.73
Desoto Ranch,CA	GW	FALLOW	ND	FALLOW		50.63	0.60	0.00	0.00
Pelican Bend Farms, AZ	GW		ALFALFA	ALFALFA	FLOODED	35.76	0.60	5.70	339.74
Vanderslice, AZ	GW		ALFALFA	ALFALFA	FLOODED	19.37	0.60	5.70	183.97
Citrus Ranch, CA	GW	ABANDON	ND	ABANDON		6.44	0.60	0.00	0.00
Frank Rascon @ Hidden Valley Resort CRIT, CA	SW	ALFALFA	ALFALFA	ALFALFA	FLOODED	53.05	0.70	5.70	431.99
Frank Rascon CRIT, CA	SW	ALFALFA	ALFALFA	ALFALFA	FLOODED	44.80	0.70	5.70	364.83
Frank Rascon CRIT, CA	SW	ALFALFA	ALFALFA	ALFALFA	FLOODED	13.36	0.70	5.70	108.77
Frank Rascon CRIT, CA	SW	ALFALFA	ALFALFA	ALFALFA	FLOODED	8.63	0.70	5.70	70.25
Frank Rascon CRIT, CA	SW	ALFALFA	ALFALFA	ALFALFA	FLOODED	10.13	0.70	5.70	82.46
Frank Rascon CRIT, CA	SW	ALFALFA	ALFALFA	ALFALFA	FLOODED	14.24	0.70	5.70	115.97
Burnell Brothers Alfalfa CRIT, CA	SW	ALFALFA	ALFALFA	ALFALFA	FLOODED	29.52	0.70	5.70	240.34
Robert Clark Farms, CA	SW	ABANDON	FALLOW	ABANDON		36.07	0.60	0.00	0.00
Rayner and Sons Deeded Farm, AZ	SW		ALFALFA	ALFALFA	FLOODED	103.52	0.60	5.70	983.17
Rayner and Sons Deeded Farm, AZ	SW		ND	FALLOW		27.76	0.60	0.00	0.00
Rayner and Sons CRIT Farm, AZ	SW		ALFALFA	FALLOW	SPRINKLER	141.52	0.70	5.70	1152.37
Desert Cotton Rodger Murphy AZ State Trust, AZ	SW		ALFALFA	GRASS	FLOODED	36.52	0.70	5.70	297.35
Cibola NWR, AZ	SW	NATIVE VEGETATION	ALFALFA	NATIVE VEGETATION	FLOODED	180.33	0.60	5.70	1713.13
Cibola NWR, AZ	SW	NATIVE VEGETATION	ALFALFA	NATIVE VEGETATION	FLOODED	142.86	0.60	5.70	1357.20
Cibola NWR, AZ	SW	NATIVE VEGETATION	ALFALFA	NATIVE VEGETATION	FLOODED	20.96	0.60	5.70	199.14
Cibola Sportsman Jim Corbett Deeded, AZ	SW	NATIVE VEGETATION	ALFALFA	NATIVE VEGETATION	FLOODED	116.66	0.60	5.70	1108.30
L. Pratt BLM, AZ	BLEND	WHEAT THEN COTTON	WHEAT	BROCOLLI	FLOODED	38.43	0.70	2.60	142.76
Ft. Yuma Tribe CA	SW	FALLOW	FALLOW	FALLOW		97.46	0.60	0.00	0.00
Huerta Packing Ft. Yuma Tribe, CA	GW		ND	ABANDON		25.71	0.60	0.00	0.00
North Cocopah Tribe, AZ	GW	FALLOW	LETTUCE/WHEAT	LETTUCE	FLOODED	46.91	0.70	4.41	295.52
Doug Mellon Farms Cocopah Tribe, AZ	GW		LETTUCE/WHEAT	LETTUCE	FLOODED	41.95	0.50	4.41	370.00
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	10.75	0.80	5.70	76.59
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	10.34	0.80	5.70	73.66
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	24.68	0.80	5.70	175.86
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	10.01	0.80	5.70	71.31
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	9.02	0.80	5.70	64.30
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	16.54	0.80	5.70	117.88
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	10.72	0.80	5.70	76.40
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	11.70	0.80	5.70	83.36
Cocopah Golf Resort Cocopah Tribe, AZ	GW	GOLF	ALFALFA	GOLF COURSE	SPRINKLER	2.27	0.80	5.70	16.20
Gary Pasquinelli BLM, AZ	GW		LETTUCE	ONION	FLOODED	11.85	0.70	2.60	44.00
Mayo Ft. Yuma Tribe, CA	BLEND	FALLOW	FALLOW	FALLOW		14.57	0.60	0.00	0.00

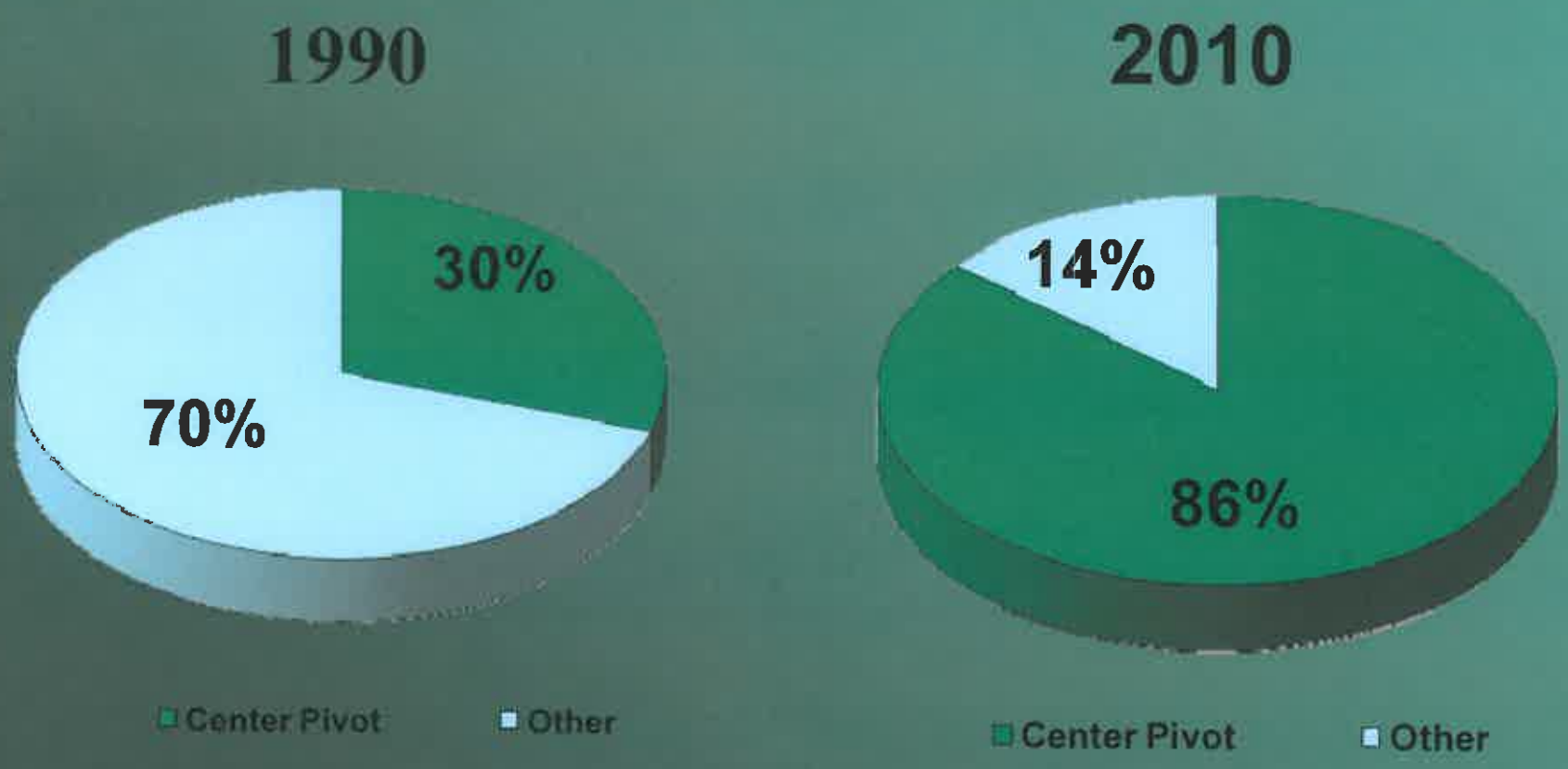
Willcox Basin

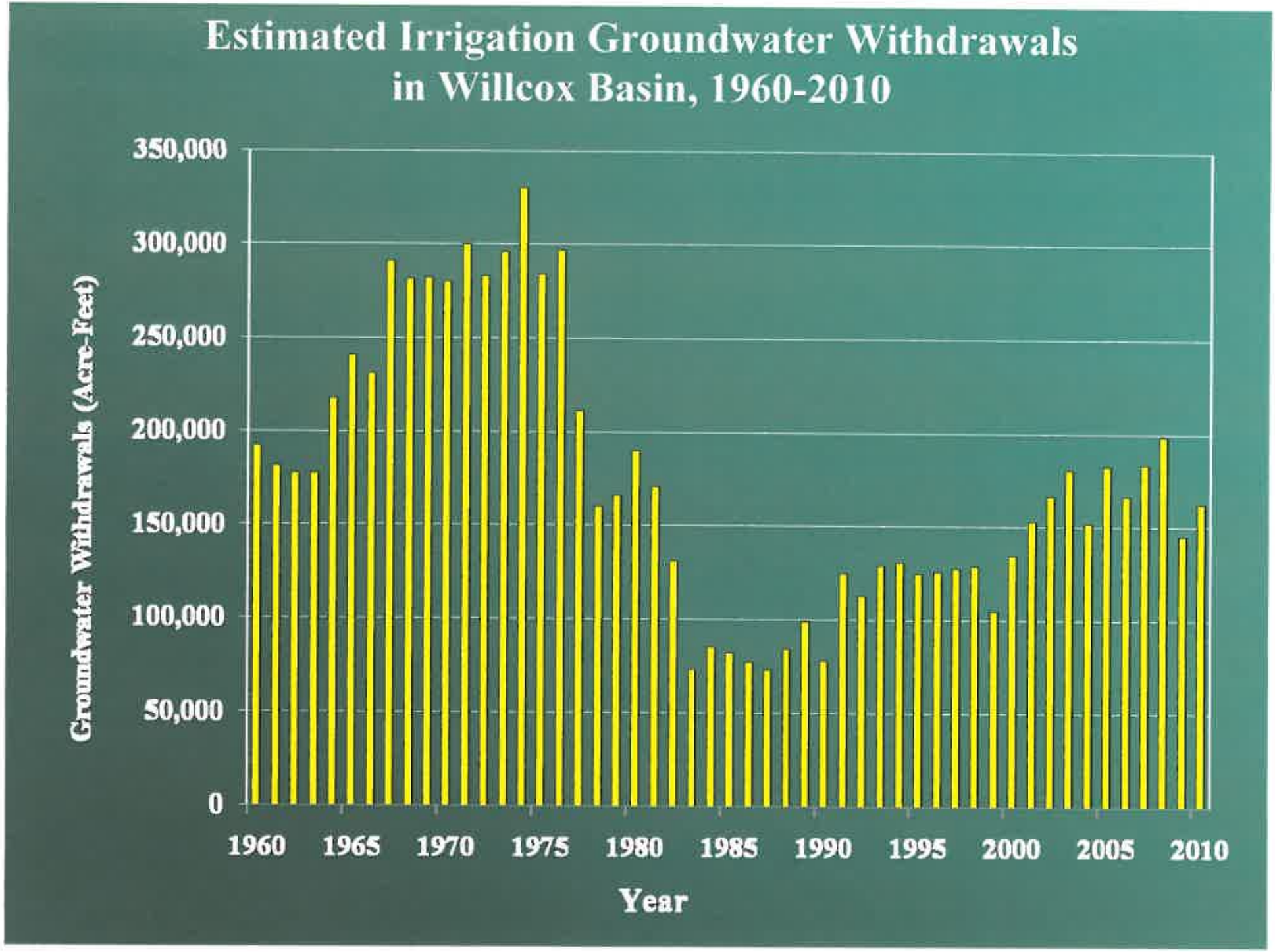


Agricultural Fields in the Willcox Basin



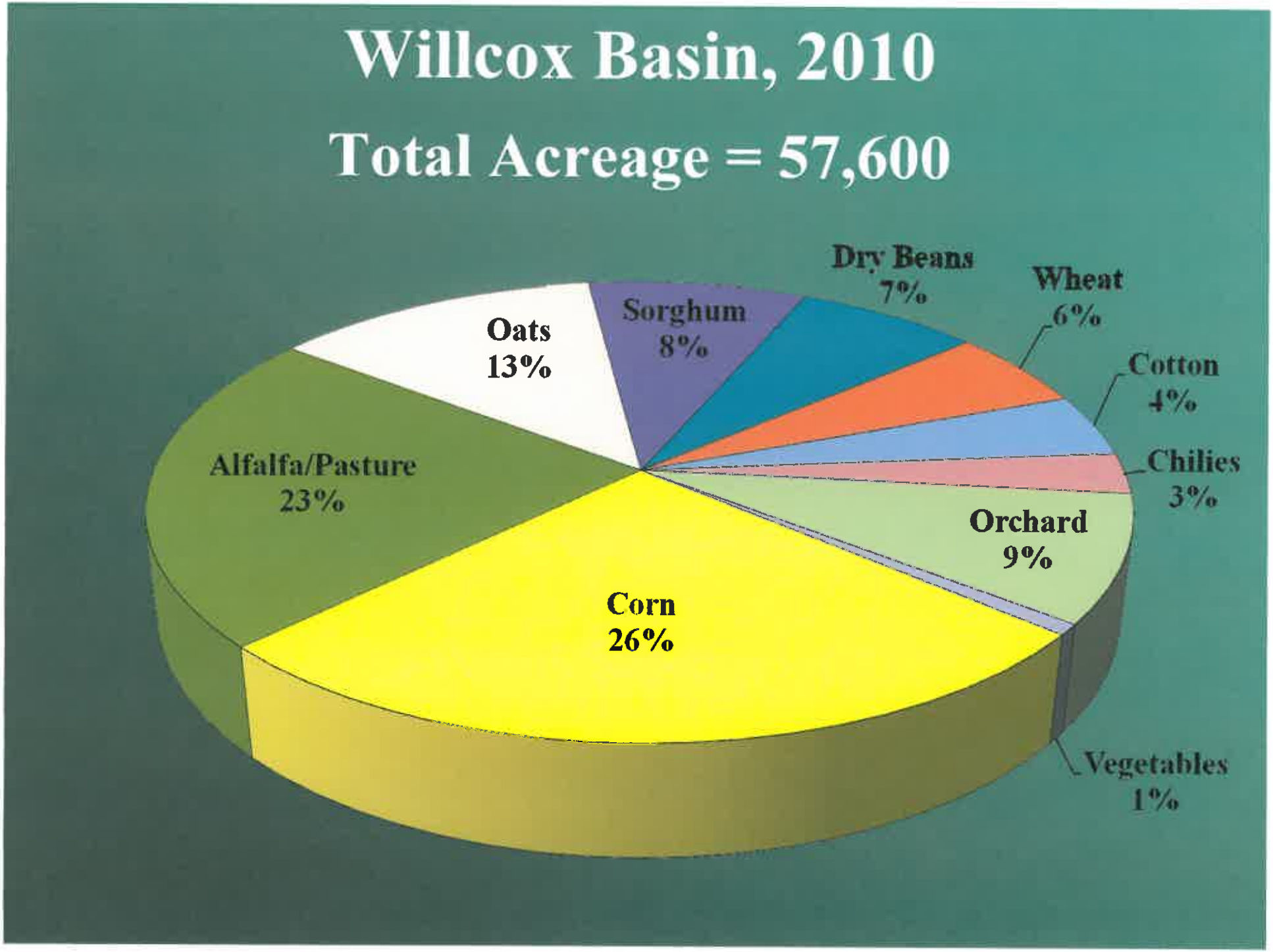
Conversion of Irrigation to Center Pivot System in the Willcox Basin

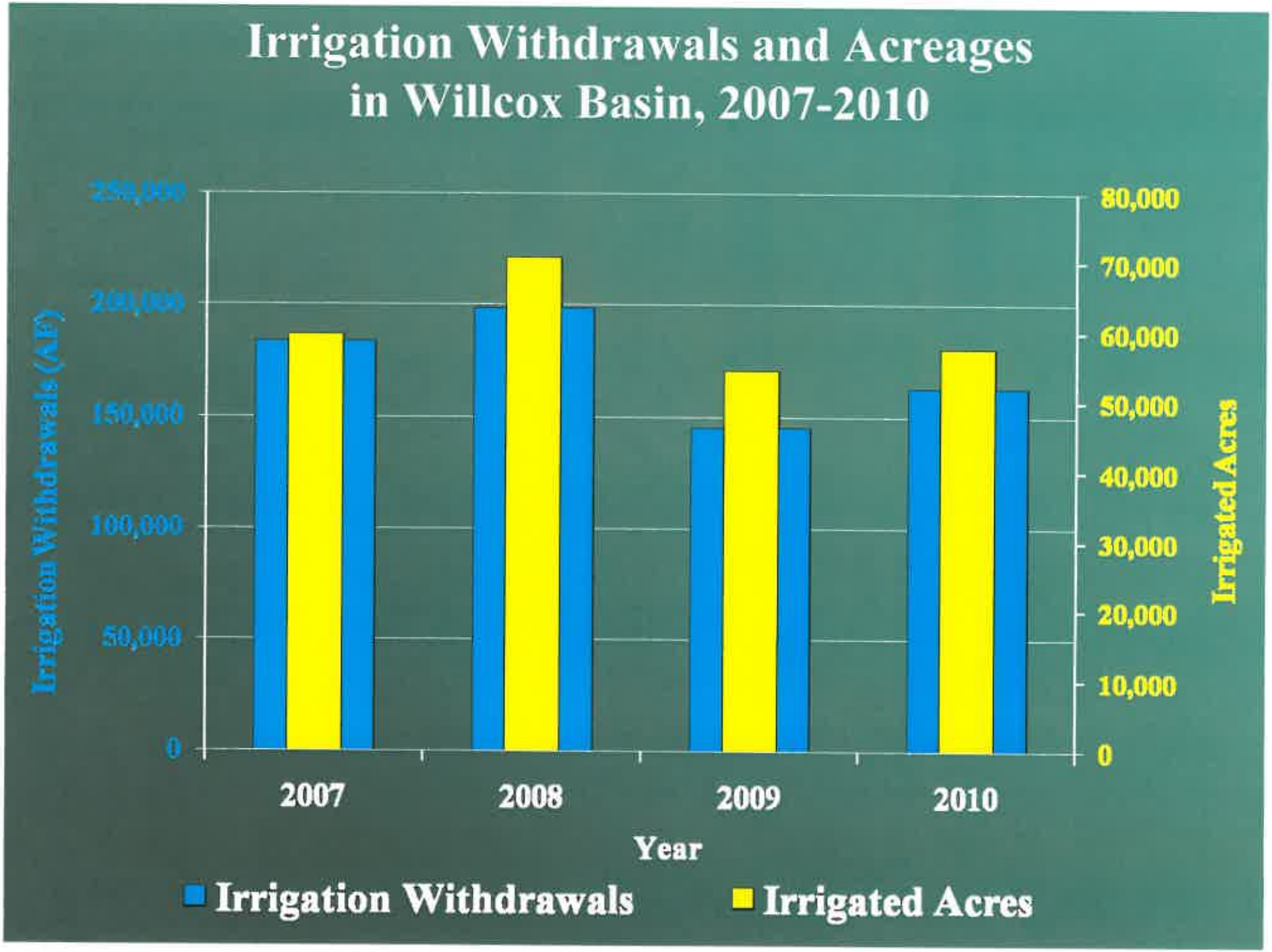



Estimated Irrigation Groundwater Withdrawals
in Willcox Basin, 1960-2010
Groundwater Withdrawals (Acre-Feet)
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

Willcox Basin, 2010

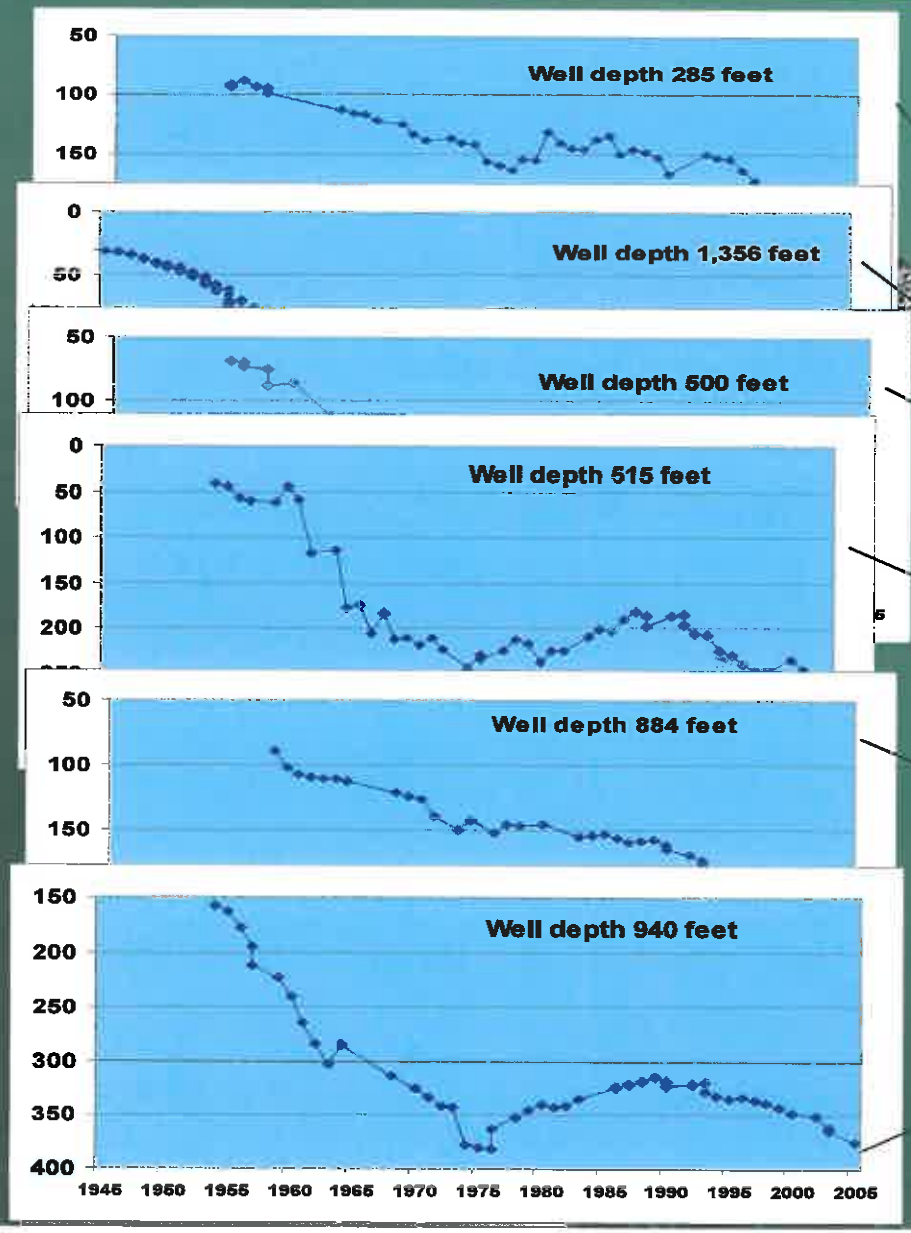
Total Acreage = 57,600

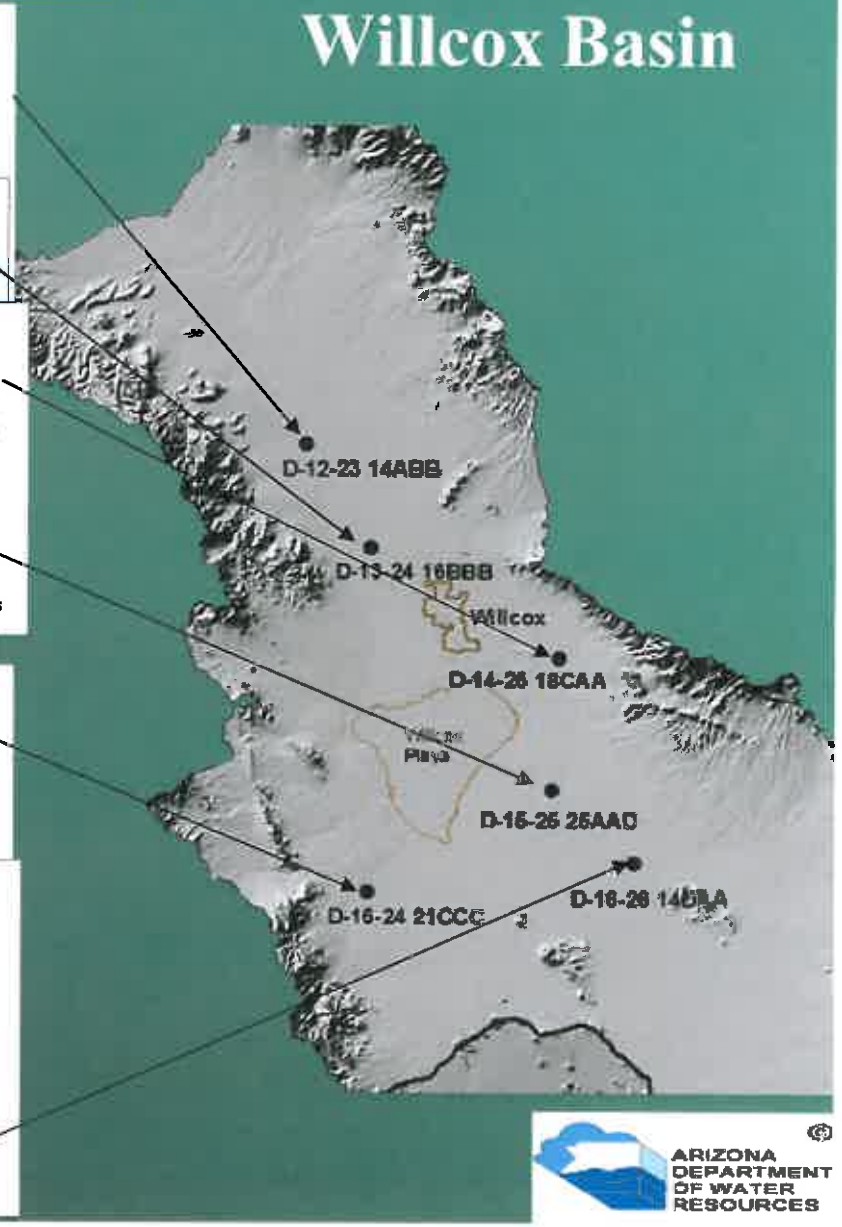



Irrigation Withdrawals and Acreages in Willcox Basin, 2007-2010
250,000
200,000
150,000
100,000
50,000
0
Irrigation Withdrawals (AF)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Irrigated Acres
2007
2008
2009
2010
Year
Irrigation Withdrawals
Irrigated Acres

Change in Well Water Levels Over Time

Source: ADWR





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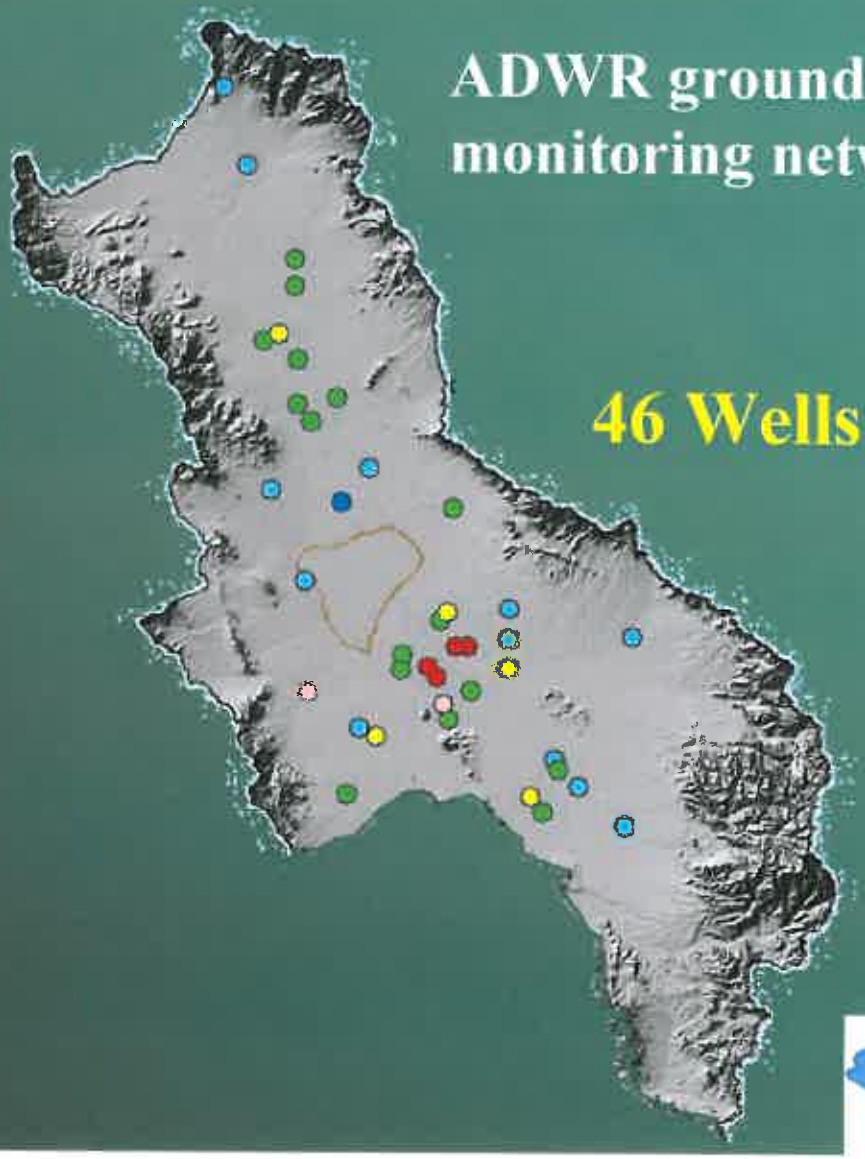
Water-Level Changes in the Willcox Basin

Source: ADWR



ADWR groundwater levels monitoring network

46 Wells

Water-level change, in feet, 1990-2005

- > -80
- -79.9 – -60.0
- -59.9 – -40.0
- -39.9 – -20.0
- -19.9 – 0.0
- 0.1 – 20.0

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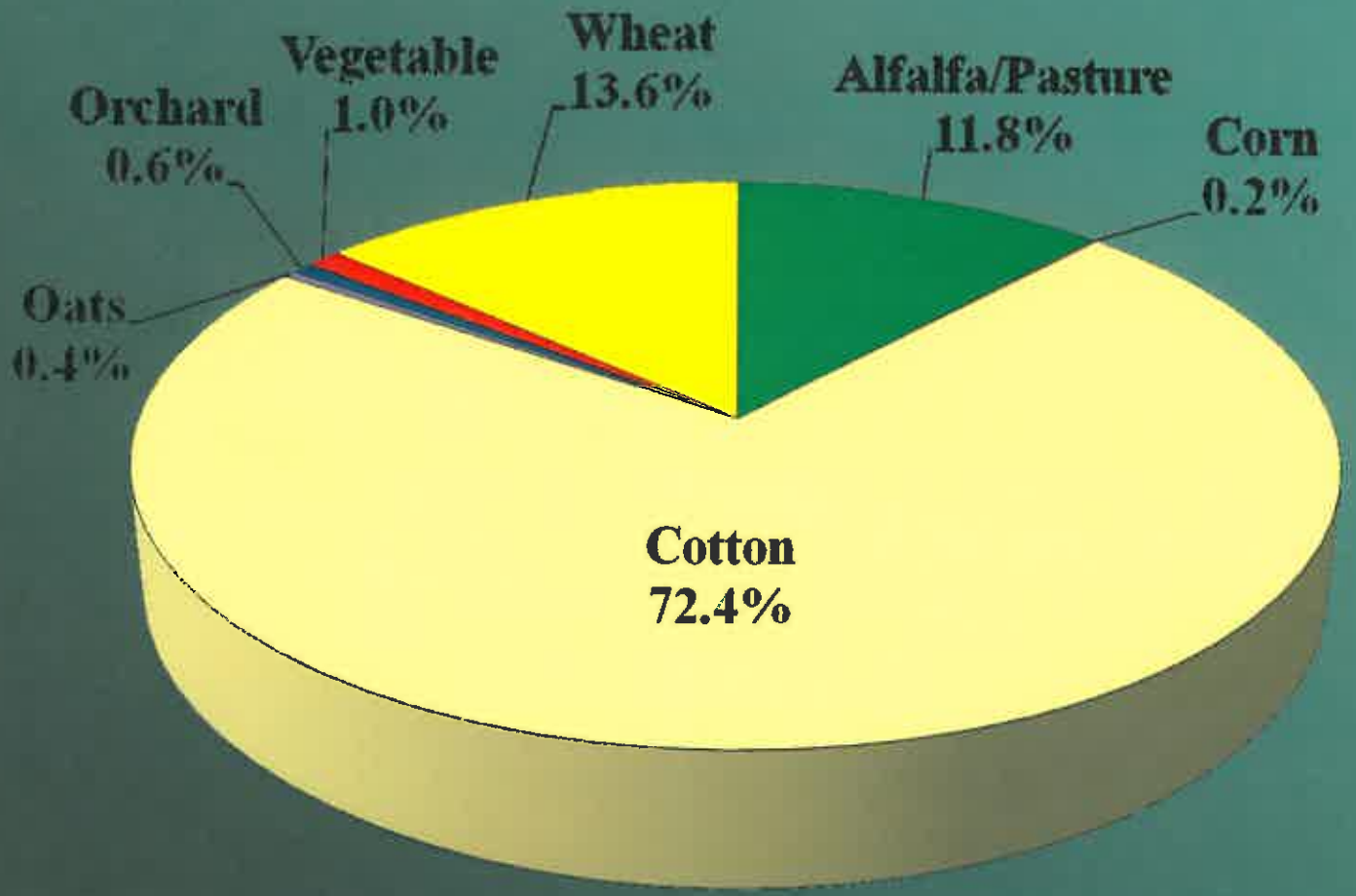
Comparison of Estimated Irrigation Withdrawals to Metered Groundwater and Surface-Water Withdrawals for 3 Areas in Arizona, 2009

Safford Area 2009

26,000 Irrigated Acres

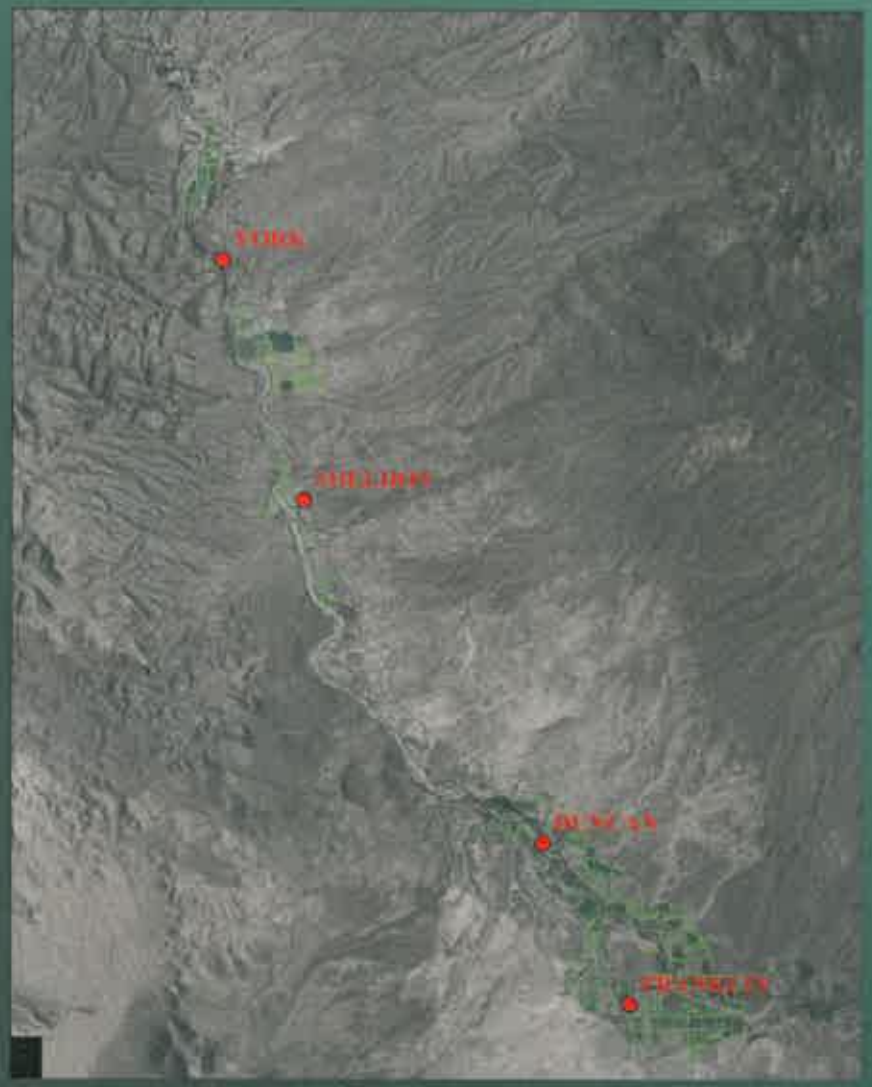
Safford Area in 2009

Total Acreage = 26,000



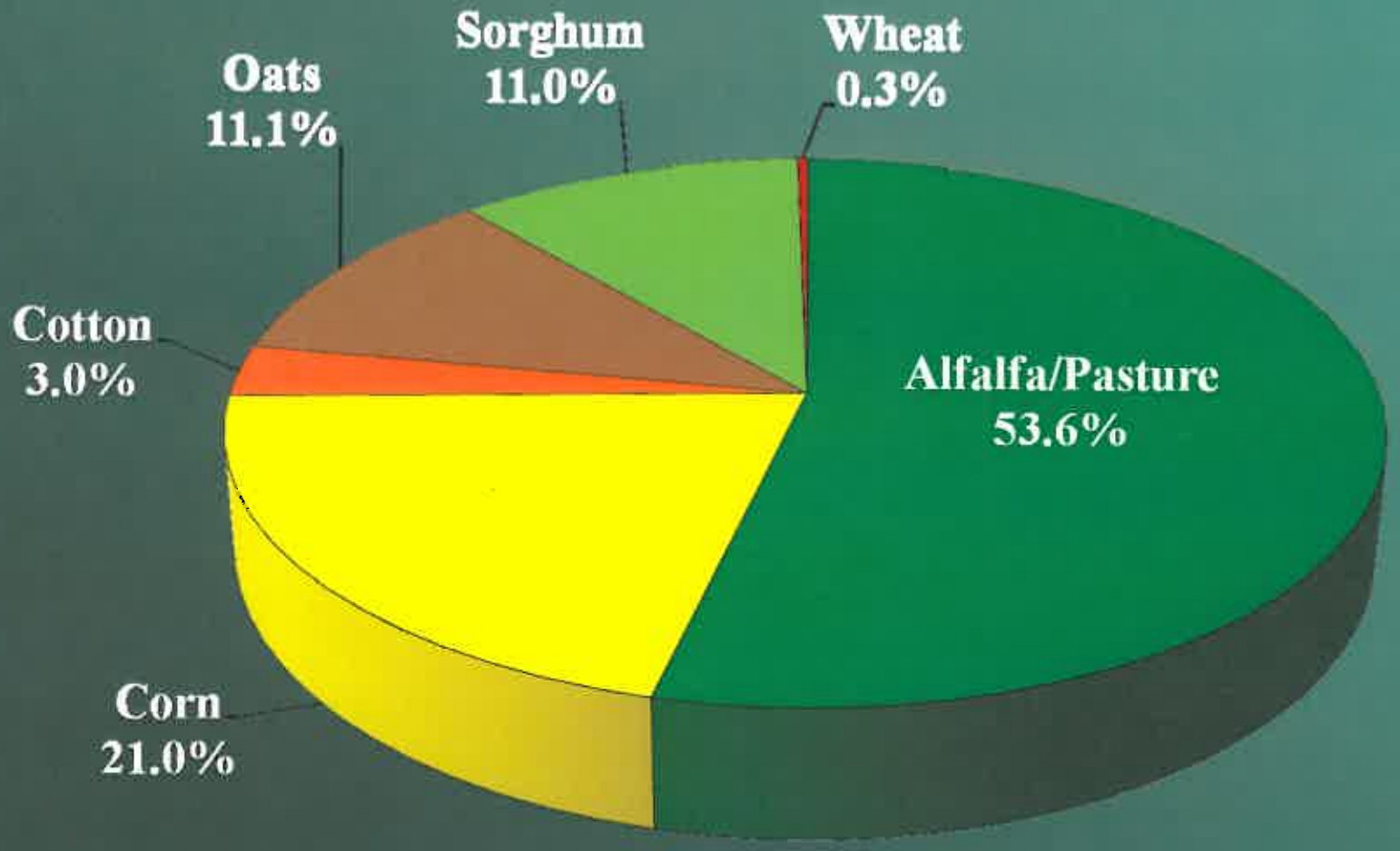
Safford Basin 2009 Field Verification

Duncan Valley Basin 2009



3,400 Irrigated Acres

Duncan Valley Basin in 2009
Total Acreage = 3,400



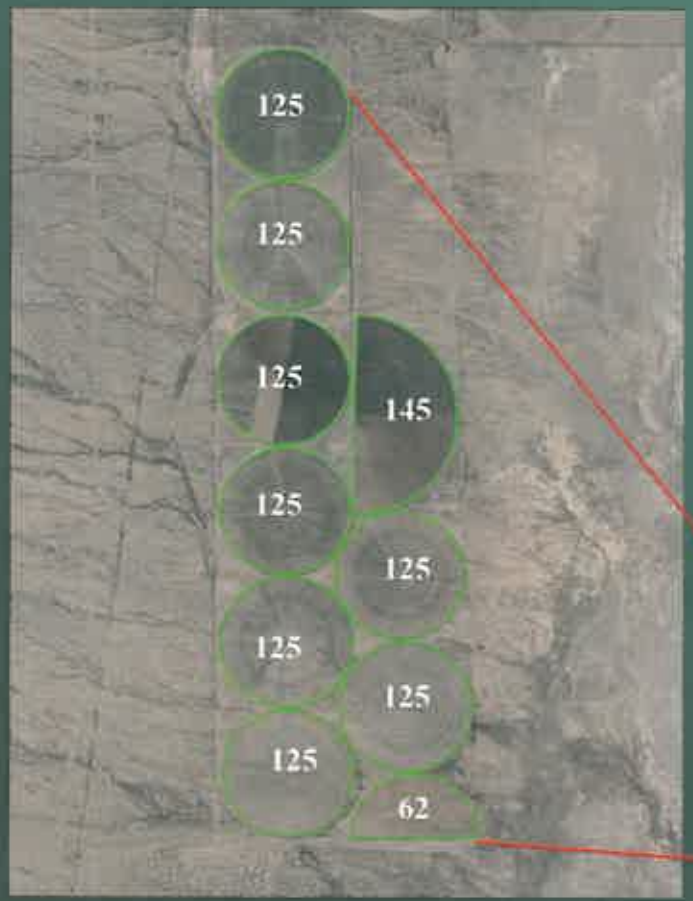
Duncan Valley Basin Field Verification 2009






Selected Alfalfa Fields in the Douglas INA

Acres Per Center Pivot



Results

Estimated Water Withdrawals vs. Metered Water Withdrawals in 2009

Location	Irrigated Acres (USGS)	Estimated Withdrawals (acre-ft) (USGS)	Metered Withdrawals (acre-ft)	Percentage Difference (USGS vs Metered Data)
Duncan Valley Basin	3,400	14,776	14,472	+2.06%
Safford Area	26,000	140,400	150,845	-6.92%

Estimated Ground-Water Withdrawals for 3 Alfalfa Center Pivots in Douglas INA, 2009

Basin	Irrigated Acres (USGS)	Estimated Withdrawals (acre-ft) (USGS)	Metered GW Withdrawals (acre-ft)	Percentage Difference (USGS vs Metered Data)
Douglas	375	1,613	1,611	+0.12%

Conclusions

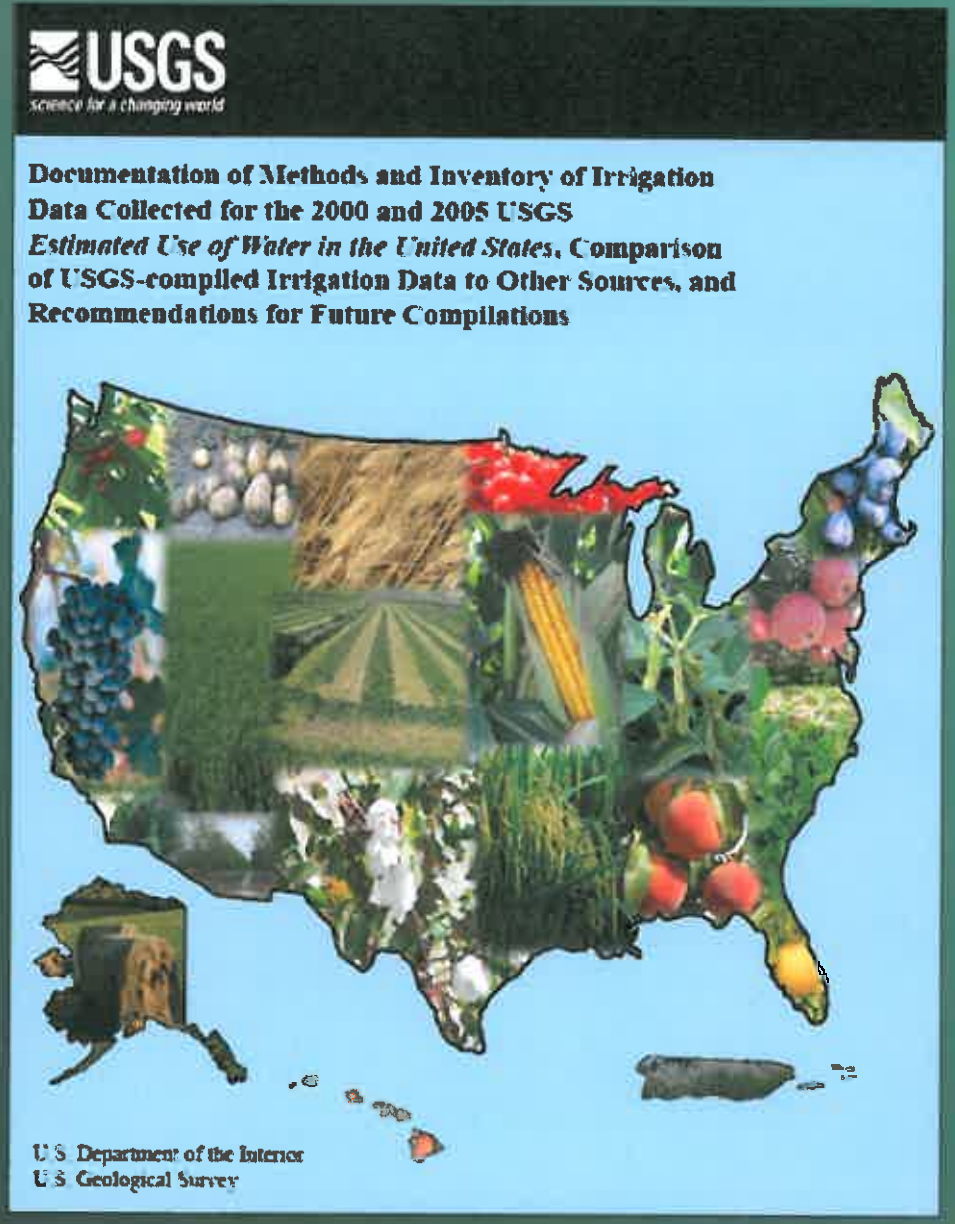
- The modified Blaney-Criddle method, in conjunction with irrigation system efficiencies and field verification, can be used to estimate irrigation withdrawals

- The comparisons with metered data conducted in 2009 produced notable results

Benefits

- Documenting trends in water use are helpful to evaluate current and potential future water needs.
- The USGS and ADWR data sets provide county and basin water-use information to local, state, and federal agencies as well as universities for assessing the effectiveness of water-management policies, regulations, and conservation activities
- Contributions to the Atlas Reports published by the ADWR and the Water Resources Development Commission Report

The Arizona Water-Use Program has been Nationally Recognized




Questions?