RECLAMATION

Managing Water in the West

Estimates of Evapotranspiration and Evaporation Along the Lower Colorado River

Calendar Year 2009

U.S. Department of the Interior
Bureau of Reclamation
Lower Colorado Region
Boulder Canyon Operations Office

Revised November 2015

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Mission Statements

The Department of the Interior protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Report Corrections

The 2009 *Estimates of Evapotranspiration and Evaporation Along the Lower Colorado River* report, as herein revised, incorporates the following changes:

- "Yuma Proving Ground, AZ"; "Yuma Proving Ground, CA"; and "Imperial National Wildlife Refuge and Yuma Proving Ground" were incorrectly included in the Parker Dam-Imperial Dam reach calculations for Riparian Vegetation and Open Water. The revised report now includes them in the Imperial Dam-Mexico reach and the calculations have been updated accordingly.

- Minor errors in Yuma County Water Users' Association Agricultural ET, Colorado River Indian Tribe, CA Open Water Evaporation, and Yuma Proving Ground, CA Open Water Evaporation were corrected.

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Acronyms

AZ	Arizona
AZMET	Arizona Meteorological Network
CA	California
CIMIS	California Irrigation Management Information System
CVWD	Coachella Valley Water District
ET	Evapotranspiration
ET_o	Reference Evapotranspiration
GIS	Geographic Information System
IID	Imperial Irrigation District
LCRAS	Lower Colorado River Accounting System
NAIP	National Agriculture Imagery Program
NV	Nevada
NWR	National Wildlife Refuge
NWS	National Weather Service
RS	Remote Sensing
SIB	Southerly International Border
TM	Thematic Mapper
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WMIDD	Wellton-Mohawk Irrigation and Drainage District
YMIDD	Yuma Mesa Irrigation and Drainage District
YPG	Yuma Proving Ground

Glossary

AZMET: A network of automated weather stations within the state of Arizona that provide reference evapotranspiration estimates.

CIMIS: A network of automated weather stations within the state of California that provide reference evapotranspiration estimates.

Crop Group: Crops with similar water use rates, grouped for the purpose of calculating evapotranspiration.

Crop Coefficient: The ratio of evapotranspiration observed for the crop studied over that observed for the reference crop under the same conditions.

Evapotranspiration: The combined effect of evaporation from the soil surface and transpiration from the plant canopy.

Fallowed/Idle Acres: The total number of acres that were left fallow or idle for the entire calendar year.

Geographic Information System: An information system that integrates, stores, edits, analyzes, shares, and displays geographic information.

Gross Cropped Acres: The total acres of crops grown, which includes multiple cropping on individual fields. Because permanent crops (i.e. alfalfa, bermuda grass, orchards and dates) may be pulled or replanted during the calendar year, the gross cropped acreage reported for permanent crops represents an average of the quarterly acreage values for a given water user. Gross cropped acres for a particular water user may be less than or greater than net cropped acres based on the following scenarios:

- When gross cropped acres are less than net cropped acres, it reflects a year in which permanent crops were pulled or replanted during the calendar year. Example: A given water user had 200 net acres of land. Of those, all 200 acres were planted in alfalfa in quarter 1. Beginning in quarter 2, 50 acres of alfalfa were pulled, leaving 150 acres of alfalfa in quarters 2, 3 and 4. In this scenario, the gross cropped acreage would be 162.5 acres (i.e. 200 + 150 + 150 + 150)/4 = 162.5 acres). The net cropped acreage would be 200 acres.
- When gross cropped acres are greater than net cropped acres, it reflects a year in which multiple crops were grown on a single field. Example: A given water user had 200 net acres of land. Of those, 200 acres of wheat were planted in the spring and 200 acres of lettuce were planted on the same fields in the fall. In this scenario, the gross cropped acreage would be reported as 200+200 = 400 acres. The net cropped acreage would be 200 acres.

Irrigable Acres: The total acres that can be irrigated and for which there exists adequate infrastructure to irrigate.

Moist Soil Unit: An area gradually flooded in winter to develop migratory waterfowl forage and not irrigated in summer.

Net Cropped Acres: The total acres on which one or more crops were grown, which does not include multiple cropping on individual fields. Does not include fallowed/idle acres. Because Reclamation's method uses the average annual acreage for permanent crops (i.e. alfalfa, bermuda, orchards and dates), gross cropped acres may be less than net cropped acres.

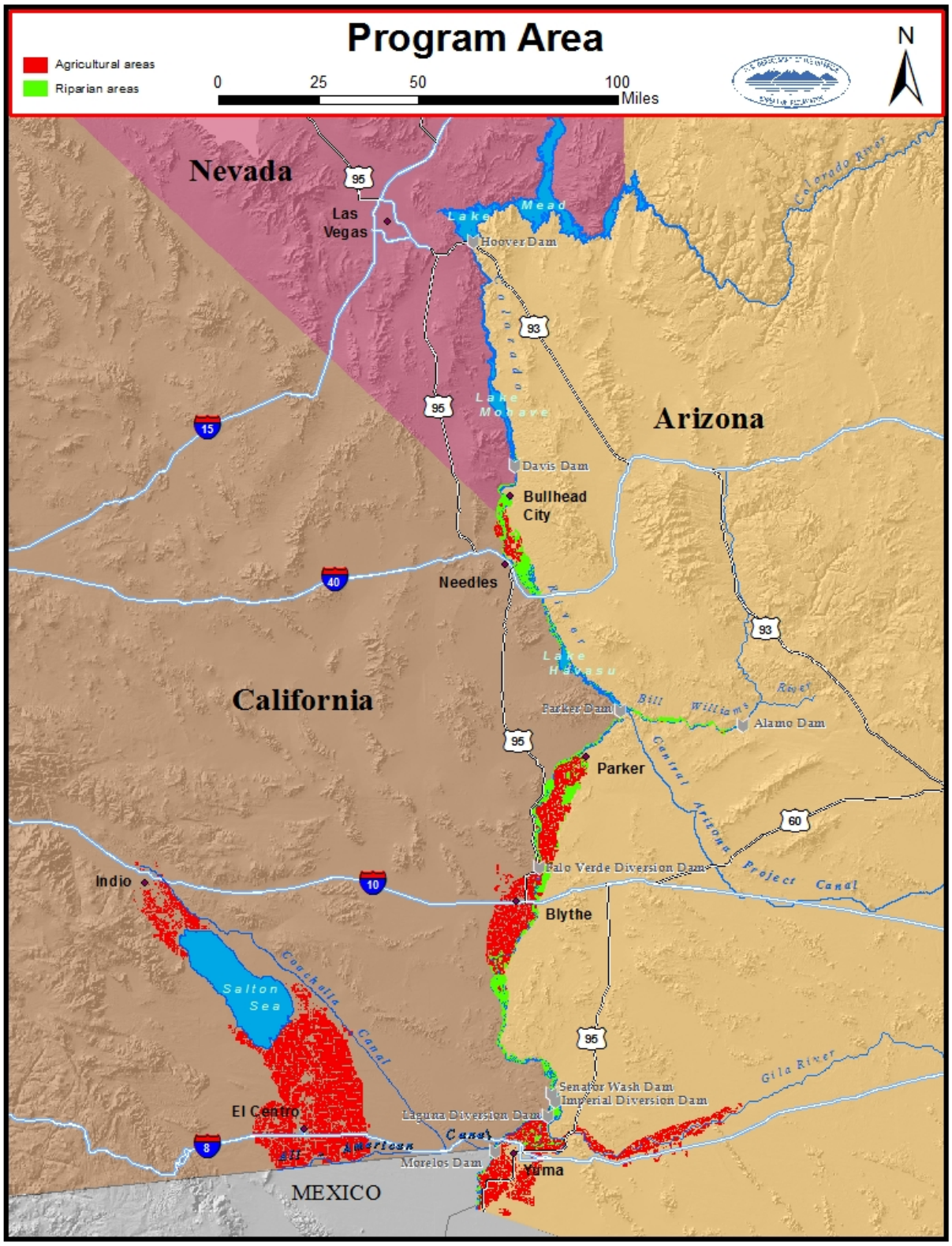
Program Area: The area in which Reclamation routinely monitors agricultural and riparian vegetation evapotranspiration and open water evaporation. Includes the lower Colorado River valley from Hoover Dam to the Southerly International Boundary with Mexico; the Wellton-Mohawk Irrigation and Drainage District on the Gila River in Arizona, and the Imperial Irrigation District and the Coachella Valley Water District in California.

Remote Sensing: A technique for obtaining information from a surface without coming into physical contact with it, using sensors and imagers that are sensing the electromagnetic radiation coming from the surface at specific wavelengths.

Reference Evapotranspiration: The evapotranspiration rate from a reference surface. The reference surface is a hypothetical reference crop with specific characteristics.

Riparian Vegetation: Riparian vegetation refers to the vegetation that grows along the shores of freshwater rivers and lakes, or along some canals. As used in this report, riparian vegetation classes also include wetland types and natural vegetation within the Lower Colorado River floodplain.

Spectral Characteristics: The amount of spectral reflectance from the Earth's surface recorded by the satellite sensors in different portions of the electromagnetic spectrum for different land cover types.


Program Area
Agricultural areas
Riparian areas
0
25
50
100
Miles
N
Nevada
Las Vegas
Lake Mead
Hoover Dam
Colorado River
Lake Mohave
Davis Dam
Bullhead City
Needles
Arizona
California
Lake Havasu
Parker Dam
Bill Williams River
Alamo Dam
Parker
Central Arizona Project Canal
Palo Verde Diversion Dam
Blythe
Indio
Salton Sea
Coachella Canal
El Centro
All American Canal
Laguna Diversion Dam
Senator Wash Dam
Imperial Diversion Dam
Gila River
Morelos Dam
Yuma
MEXICO
15
40
10
8
95
93
60

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Executive Summary

The Secretary of the Interior, as the "Watermaster" for the Lower Colorado River, acts through the Bureau of Reclamation (Reclamation) to manage the waters of the Colorado River for the benefit of water users in the Southwestern United States and Mexico. A significant component of the Watermaster role, a component mandated by the United States Supreme Court Decree of 1964 in Arizona *v*. California, is to account for water use by each state and individual water user. In this capacity, Reclamation administers a number of programs, some of which utilize remote sensing technology to monitor and provide estimates of annual agricultural and riparian vegetation water use, and open water evaporation along the lower Colorado River from Hoover Dam to the Southerly International Border (SIB) with Mexico. Reclamation provides an annual summary of this information through publication of this report. Reclamation has reported this data since 1995, in reports previously entitled, "Lower Colorado River Accounting System Evapotranspiration and Evaporation Calculations."[1] Beginning with this 2009 report, Reclamation has reformatted the way in which the data are presented in an effort to provide a more user-friendly product that better serves the reader.

Specifically, Reclamation calculates estimates of:

- Evapotranspiration (ET) from irrigated agricultural areas.
- ET from riparian vegetation.
- Evaporation from the mainstream channel and reservoirs of the lower Colorado River.
- Evaporation from canals, lakes, lagoons, and other open water areas along the river.
- Agricultural data, by water user, including the types of crops grown and acreages.

More than 3.5 million acres are monitored within the program area. This acreage includes:

- Irrigation districts, Indian reservations, Federal recreation areas, and wildlife refuges located along the mainstream of the lower Colorado River, as well as the Bill Williams River from below Alamo Dam to Lake Havasu.
- The Wellton-Mohawk Irrigation and Drainage District on the Gila River in Arizona.
- The Imperial Irrigation District and the Coachella Valley Water District in California.

The total estimated agricultural ET in 2009 was approximately 2,988,400 acre-feet. Total estimated agricultural ET in 2008 was approximately 3,133,900 acre-feet, representing a 4.6% decrease in 2009.

[1] Copies of this and previous years' reports may be found on Reclamation's website at: www.usbr.gov/lc/region/g4000/wtracct.html.

Table ES-1 provides a summary of the predominant crops grown within the program area during calendar year 2009 and the acreages associated with each crop. More detailed information including water users' agricultural acreage (irrigable, gross cropped, net cropped, and fallowed/idle acres), crop types and acreages, agricultural ET by crop type, riparian vegetation acreage and ET, and open water acreage and evaporation has been included in Appendix 1. For select water users, the appendix also provides the historical five-year trend (calendar years 2004-2009) of the user's total diversions, consumptive use (diversions less measured and unmeasured return flows, as reported in Reclamation's 2009 *Colorado River Accounting and Water Use Report, Arizona, California, and Nevada*), and agricultural ET (crop ET minus effective precipitation).

Table ES- 1. Major Crops Grown in Calendar Year 2009.

Crop	**Acres**
Alfalfa	265,710
Small Grains (Wheat, Oats, Rye, Barley, Millet)	182,025
Lettuce (Head, Leaf Red, Leaf Green, Spinach)	123,574
Bermuda/Grass (Bermuda Overseeded with Rye, Klein, Timothy)	76,632
Sudan (Includes Sesbania and Clover)	64,091
Small Vegetables (Carrots, Cilantro, Celery, Garlic, Dry Onions, Onions, Parsley, Radishes, Flowers)	45,918
Other (e.g. Citrus, Crucifers, Cotton, Dates, Field grains, Grapes, Melons, etc.)	182,475
Total	**940,425**

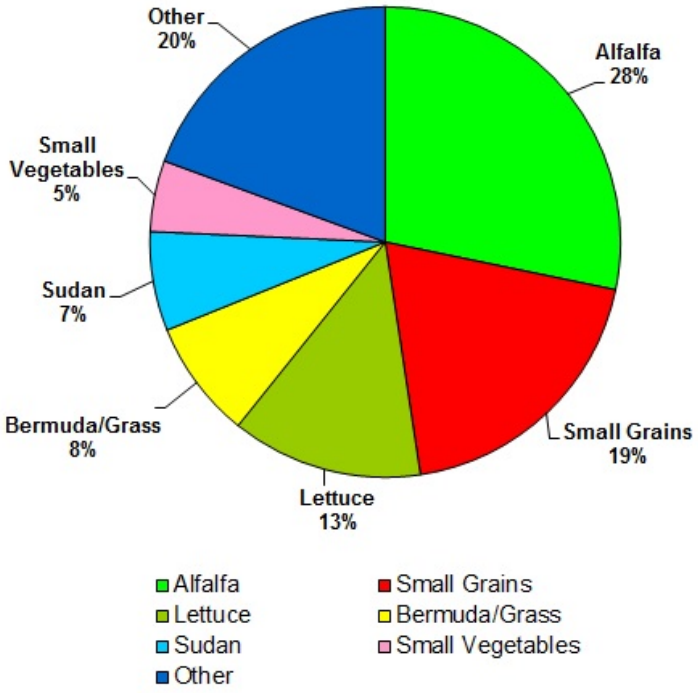

Figure ES-1. Major Crops Grown in Calendar Year 2009. (Based on Gross Cropped Acres.)

1.0 Introduction

The Colorado River has often been termed the "Lifeblood of the Southwest." Beginning in the Rocky Mountains of north central Colorado, the river travels more than 1,400 miles before it empties into the Gulf of California, commonly referred to the Sea of Cortez. Together with its tributaries, the Colorado River drains approximately 242,000 square miles in the United States, one-twelfth of the country's continental land area, and 2,000 square miles in Mexico.

The Colorado River and its tributaries provide water to nearly 40 million people for municipal use, supply water to irrigate nearly 5.5 million acres of land, and are the lifeblood for at least 22 federally recognized tribes, 7 National Wildlife Refuges, 4 National Recreation Areas, and 11 National Parks. In the Lower Colorado River Basin States of Arizona, California, and Nevada (Lower Division States), the river serves major cities such as Phoenix, Los Angeles, and Las Vegas. The moderate climate of the lower Colorado River basin lends itself to being one of the most productive agricultural regions in the nation. Agriculture use accounts for the largest component of the river's consumptive use in the lower basin, supporting an agricultural economy worth billions of dollars.

Figure 1. Map of the Colorado River hydrologic basin and areas adjacent to the hydrologic basin that receive Colorado River water.

As the Watermaster for the lower Colorado River, the Bureau of Reclamation must understand the disposition of water once it is released from Hoover Dam in order to effectively manage resources of the lower Colorado River. Because the agricultural sector comprises such a large component of the river's use in this region, it is important to have a comprehensive understanding of current agricultural practices and their associated water use. As competition for the Colorado River resource continues to increase, water managers will require accurate and reliable sources of data upon which to make sound decisions regarding future water management policies to ensure a

sustainable water supply is available to meet future demands. This is particularly true for the Lower Division States, as each of these states has the ability to fully utilize its Colorado River apportionment.

2.0 Lower Colorado River Acreage and Water Use Estimates

This report provides estimates of agricultural, riparian vegetation, and open water acreages and water uses along the lower Colorado River from Hoover Dam to the Southerly International Border (SIB) with Mexico. Reclamation has reported this data since 1995, in reports previously entitled, "Lower Colorado River Accounting System [LCRAS] Evapotranspiration and Evaporation Calculations." A detailed history of the LCRAS program and the work that was performed related to its development is presented in the United States Geological Survey (USGS) Water Supply Paper 2407 (Owen-Joyce and Raymond, 1996). Beginning with this 2009 report, Reclamation has reformatted the way in which the data are presented in an effort to provide a more user-friendly product that better serves the end-user.

This section provides a general overview of Reclamation's acreage and water use monitoring program, including a description of the program area and its elements. Section 3 provides a description of the procedures and methods; Section 4 provides the results of the 2009 monitoring program; and Section 5 discusses program improvements and/or changes that occurred in 2009.

2.1 Program Area

The area monitored by Reclamation includes the lower Colorado River valley from Hoover Dam to the SIB. Reclamation has routinely monitored agricultural and riparian vegetation ET and open water evaporation along the mainstream since 1994, and along the mainstream and Bill Williams River below Alamo Dam since 2001. Beginning in 2004, the program area was expanded to include the Wellton-Mohawk Irrigation and Drainage District (WMIDD) on the Gila River in Arizona, and the Imperial Irrigation District (IID) and the Coachella Valley Water District (CVWD) in California. With this expansion, the extent of the area analyzed more than doubled from approximately 1.2 million acres to nearly 3.5 million acres (Figure 2). Correspondingly, the number of fields analyzed also increased from approximately 50,000 fields to over 125,000 fields. Figure 2 illustrates the program area before and after the expansion.

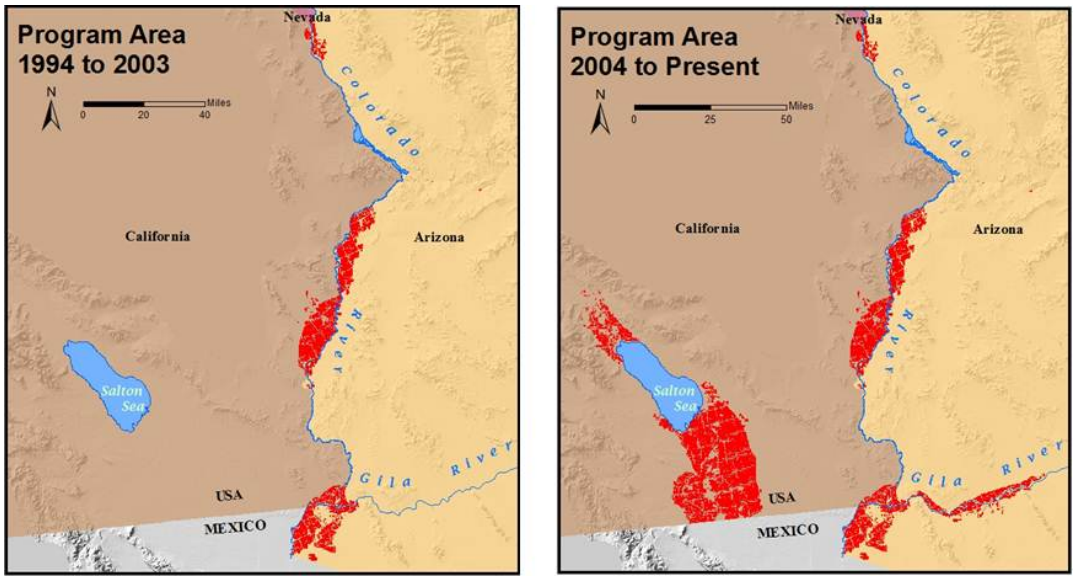

Figure 2. Program Area Extent: (1) 1994-2003 (original) and (2) 2004-Present (with the addition of WMIDD, IID, and CVWD). Program area includes riparian and open water areas, which are not shown here.

2.2 Program Elements

Reclamation's remotely-sensed data collection and monitoring program provides the following types of data:

1. Estimates of ET from irrigated agricultural areas.
2. Estimates of ET from riparian vegetation.
3. Estimates of evaporation from the mainstream channel and reservoirs of the lower Colorado River.
4. Estimates of evaporation from canals, lakes, lagoons, and other open water areas along the river.
5. Estimates of agricultural data, by water user, including the types of crops grown and acreages.

Reclamation uses this information to support a variety of program-related administrative requirements, including to monitor the current state of the river system, to assess potential impacts of changes to the river system, and as inputs to management decisions involving the administration of the federal laws, compacts, court decisions and decrees, contracts, and regulatory guidelines, collectively known as "The Law of the River," which govern the diversion and use of Colorado River water. Examples of how Reclamation uses this data include:

1. To assist in verifying Colorado River water users' success in meeting conservation targets under the Inadvertent Overrun and Payback Policy, Intentionally Created Surplus, and/or System Conservation programs.
2. To develop spatial databases representing locations of crops, riparian vegetation, and open water surfaces of the Colorado River, lakes, and canal systems.
3. To statistically quantify the types and acres of crops, riparian vegetation groups, and open water surface areas.
4. To perform economic analyses for land use conversions.
5. To refine and improve upon unmeasured return flow estimates.
6. To assist in making water entitlement and beneficial use determinations.
7. To assist in making determinations of unauthorized use.

Reclamation provides an annual summary of the land cover types, acreages, and associated evapotranspiration and evaporation for agricultural, riparian vegetation, and open water areas within the program area through publication of this report. Copies of this and previous years' reports can be found on Reclamation's website at: www.usbr.gov/lc/region/g4000/wtracct.html.

3.0 Procedures and Methods

Reclamation uses Remote Sensing (RS) and Geographic Information Systems (GIS) technologies to identify the location and quantify the acreages of crop groups, riparian vegetation groups, and open water areas in the program area. Riparian vegetation is monitored only in the Colorado River floodplain; it is not monitored in the IID, CVWD, or WMIDD areas. The spatial extent (location and area of coverage) of the crop groups, riparian vegetation groups, and open water areas is stored in digital spatial databases collectively referred to as a GIS database. Reclamation uses the data generated from the RS and GIS processes to calculate ET from crops and riparian vegetation, and evaporation from open water areas.

When RS processes alone are insufficient to map crop and riparian vegetation groups or open water areas, data collected on the ground (ground reference surveys) are also used. For example, orchards are mapped using data collected from ground reference surveys due to the difficulty of correctly identifying features related to this type of crop using RS processes alone. Once the data are entered into a GIS database, programs are used to calculate the number of acres of each crop group and riparian vegetation group for each water user, as well as the number of acres of open water areas. Acreage calculations are completed for areas located within the program area.

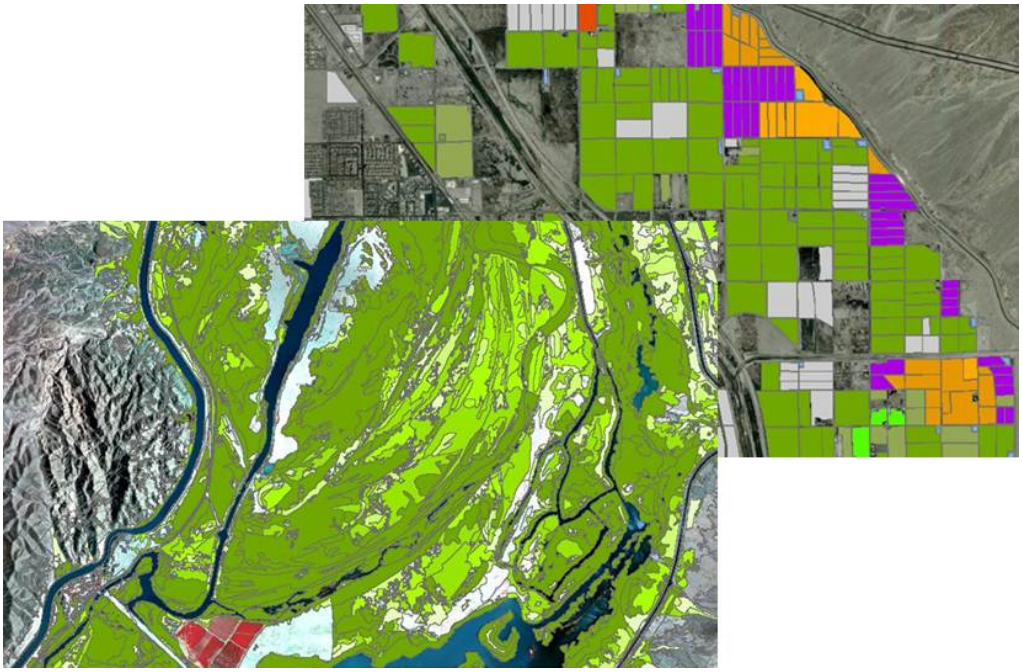

Figure 3. Reclamation uses RS and GIS processes to map crop and riparian vegetation groups and to estimate the evapotranspiration associated with these groups.

Once Reclamation maps the crop and riparian vegetation groups and open water areas (as discussed in the following sections), Reclamation calculates the ET from crops and riparian vegetation for each water user and evaporation from open water areas. Currently, this analysis does not include estimates of ET or evaporation within the boundaries of domestic water users. Areas with identified crops and/or riparian vegetation not located within a known water user boundary are mapped and labeled with the name of the state in which they are located (e.g. State of Arizona, Other Users, Davis Dam to Parker Dam).

The key components of ET and evaporation calculations include:

1. Identifying crop and riparian vegetation groups, and open water areas.
2. Calculating ET for crop groups and riparian vegetation groups.
3. Calculating evaporation from open water areas (i.e. the mainstream channel and reservoirs of the lower Colorado River, major delivery canals, ponds, and other open water areas).

Sections 3.1 through 3.3 present a brief description of each of these components.

3.1 Identifying Crop Groups, Riparian Vegetation Groups, and Open Water Areas

This section provides an overview of the image classification processes and GIS technologies Reclamation uses to identify and map crop and riparian vegetation groups, and open water areas within the program area.

3.1.1 Collecting and Analyzing Remotely-Sensed Data

Satellite imagery is acquired from Landsat Thematic Mapper (TM) sensors and other satellite or airborne imaging systems as needed. For its analysis, Reclamation selects satellite images that adequately cover the program area, are cloud-free, and capture the variation in crop planting practices during the year.

3.1.2 Collecting Ground Reference Data

Correctly identifying and mapping crop and riparian vegetation groups using remotely-sensed data requires a thorough understanding of the spectral characteristics of vegetation types for representative (ground reference survey) sites throughout the program area. TM satellite image data contain digital values that represent the spectral characteristics of these crop and riparian vegetation groups. Reclamation analyzes these digital values within ground reference survey sites to generate spectral statistics for specific crop and riparian vegetation groups.

Reclamation collects ground reference survey data for approximately 12 percent of the irrigated fields in the program area. Reclamation uses 60 to 65 percent of the ground reference survey data for image classification processing (to identify crop groups) and the remaining 35 to 40 percent to assess the accuracy of the image classifications. Reclamation selects ground reference survey sites in each major irrigated area involved in this analysis. To provide a statistically valid data set, Reclamation selects irrigated fields from a GIS database using a stratified random sample and adds additional fields to the random sample, where necessary, to ensure representation of all major crop groups.

Table 1 provides a listing and description of the common crop groups identified within the program area. Although cropping patterns may vary yearly depending on market conditions, the types of crops grown within the program area generally remain consistent over the long-term.

Table 1. Crop Groups Identified within the Program Area.

Crop Group	Description
Alfalfa	Alfalfa
Aloe	Aloe
Bermuda/Grass	Bermuda, Bermuda Overseeded with Rye, Klein grass, Timothy grass
Cane/Bamboo	Cane/Bamboo
Citrus	Young (1-2 meters tall) Mature (2+ meters tall) Declining
Cotton	Cotton
Crucifers	Broccoli, Cauliflower, Cabbage, Bok-Choy, Mustard, Kale, Okra
Dates	Dates
Deciduous Orchards	Pecans, Peaches, Almonds
Fallow/Idle	Fields currently not in production; includes bare cultivated soil
Field grains	Field Corn, Sorghum, Milo
Grapes	Grapes
Jojoba	Jojoba
Legumes/Solanum Vegetables	Green, Dry and Garbanzo Beans; Peas, Peanuts, Fresh Peppers, Potatoes
Lettuce	Spring and Fall (Head, Leaf [Red], Leaf [Green], Spinach, Other Lettuce)
Melons	Spring and Fall (Watermelon, Honeydew, Cantaloupe, Squash, Cucumbers)
Miscellaneous Herbs	Anise, Mint, other
Moist Soil Unit	An area gradually flooded in winter to develop migratory waterfowl forage and not irrigated in summer
Nursery or Greenhouse	Citrus Nursery, Native Nursery, Greenhouse, Other Nursery
Perennial Vegetables	Artichoke, Asparagus, Guayule
Root Vegetables	Table Beets, Parsnip, Turnip, Rutabaga
Oil Crops	Safflower, Canola, Sunflower, Sesame
Small Grains	Oats, Rye, Barley, Millet, Wheat
Small Vegetables	Carrots, Cilantro, Celery, Garlic, Dry Onions, Onions, Parsley, Radishes, Flowers
Sudan	Includes Sesbania and Clover
Sugar Beets	Summer and Winter
Tomatoes	Tomatoes
Other	

Table 2. Riparian Vegetation Groups Identified within the Program Area.

Riparian Group	Description
Marsh	40% cattail, bulrush, and phragmites
Barren	Less than 10% vegetation
Sc_low	11% to 60% salt cedar and less than 25% arrowweed
Sc_high	61% to100% salt cedar and less than 25% arrowweed
Sc/ms	11% to 60% salt cedar, 11% to 60% mesquite, and less than 25% arrowweed
Sc/aw	Less than 75% salt cedar and 25% or more arrowweed
Sc/ms/aw	15% to 45% salt cedar, 15% to 45% mesquite, and 20% to 40% arrowweed
Ms-low	11% to 60% screwbean and honey mesquite, and less than 25% arrowweed
Ms-high	61% to 100% screwbean and honey mesquite, and less than 25% arrowweed
Ms/aw	21% to 60% mesquite, 31% to 60% arrowweed, and less than 20% salt cedar
Aw	51% to 100% arrowweed and less than 10% any trees
Cw	61% to 100% cottonwood and willow
Low veg	Greater than 10% and less than 30% any riparian vegetation

Table 2 provides a list and description of the riparian vegetation groups identified within the program area.

3.1.3 Delineating Cropped Areas

Reclamation has developed a spatial relational database that delineates field borders for all irrigated areas included in this analysis (field-border database). Reclamation has linked all ground reference survey data collected for image classification to this field-border database.

Reclamation routinely updates the field border database to reflect actual conditions observed in the field during collection of the ground reference sample data. Reclamation also uses 30-meter TM imagery, and 1- and 2-meter United States Department of Agriculture National Agricultural Imaging Program (NAIP) digital photography to update and create new field-border databases.

Delineated cropped areas include all areas known by Reclamation to divert or pump water along the mainstream of the lower Colorado River from Davis Dam to Mexico, WMIDD, IID, CVWD, and irrigated areas along the Bill Williams River from below Alamo Dam to Lake Havasu. (See Appendix 3, Exhibit 1 for an index of water user boundaries, and Exhibits 1 through 6 for illustrations of these areas.)

Using the RS technology with the GIS field border database, Reclamation identifies the crop(s) grown in each agricultural field throughout the calendar year. Post-classification accuracy assessments show that, overall, Reclamation routinely achieves an average accuracy of 90 percent or greater when mapping crop groups in the program area.

Reclamation completed a study with an independent statistician to quantify the effects of remote sensing-based crop classification error on accuracies of ET estimates. To review the results of this study, see Stehman, S.V. and Milliken, J.A. (2007), "Estimating the effect of crop classification error on evapotranspiration derived from remote sensing in the lower Colorado River basin, USA." *Remote Sensing of Environment*, 106, pp. 217 – 227.

Figure 4. Landsat satellite image showing agricultural fields in the Imperial Irrigation District with digitized field borders.

3.1.4 Delineating Riparian Vegetation Areas

Reclamation updates riparian vegetation areas along the Colorado River floodplain by comparing the current year Landsat TM summer satellite images to the previous year's images (change detection methods[2]). Reclamation field checks areas of spectral change to confirm that the change is actually due to a change in land cover. Reclamation then remaps areas of land cover change and uses these maps to update the riparian vegetation database.

3.1.5 Delineating Open Water Areas

An open water GIS database contains the spatial boundaries of open water surfaces including: the mainstream of the Colorado River, reservoirs, backwaters and canals. Reclamation annually compares current-year satellite imagery to previous year imagery and updates the open water surface area as necessary.

[2]See, *Lower Colorado River Accounting System, Calendar Year 2001*, *Demonstration of Technology Report*, Chapter 6, 6.23 - 6.26.

Reclamation calculates evaporation from major delivery canals that serve water users within the Yuma area. Reclamation identifies bank-to-bank area (in acres) in these canals by digitizing canal banks from satellite and airborne imagery.

3.2 Calculating Crop and Riparian Vegetation ET

Reclamation calculates ET from crop groups and riparian vegetation groups using the following data:

1. Reference ET.
2. ET coefficients for each crop and riparian vegetation group.
3. Number of acres and location of each crop and riparian vegetation group.
4. Effective precipitation (used to calculate crop ET only).

The following sections describe the methods utilized by Reclamation to calculate these data.

3.2.1 Calculating Reference ET

Reference ET represents a fundamental measure of the rate of water use by vegetation (in linear units, such as inches) to which the rate of water use of all types of vegetation (as well as the rate of evaporation from a water body) can be related.

Reclamation calculates reference ET values using the standardized Penman-Monteith equation developed by the American Society of Civil Engineers (standardized equation), and climatological data provided by California Irrigation Management Information System (CIMIS) and Arizona Meteorological Network (AZMET) automated weather stations located in irrigated areas along the Colorado River from Davis Dam to Mexico. The standardized equation is widely accepted by science/engineering communities, and is considered the most accurate method currently available. The AZMET and CIMIS stations continuously collect maximum, minimum, and average air temperature and relative humidity; average soil temperature at depths of 2- and 4-inches, wind speed, and precipitation data; and calculate net solar radiation. These parameters, with the exception of precipitation, are used to calculate hourly and daily reference ET values.

Table 3 provides a list of the stations used to collect the reference ET data used in Reclamation's calculations and the corresponding geographical areas for which each station's data are applied. Appendix 2 contains the following additional information (averaged for each geographical area referenced in Table 3): monthly reference ET, monthly precipitation, and monthly ET rates for crop and riparian groups.

Table 3. Area Weather Stations Used for the Calculation of Average Reference ET and Precipitation.

Geographical Area	Weather Stations		
	AZMET	CIMIS	NWS*
Mohave Valley area	Mohave Mohave II	--	Bullhead City
Parker/Palo Verde valleys	Parker Parker II	Blythe NE Ripley Palo Verde II	Blythe-Airport Ehrenberg 2E Parker Blythe
Wellton-Mohawk area	Roll	--	Tacna 3 NE
Imperial/Coachella valleys	--	Calipatria/Mulberry Seeley Meloland La Quinta II Indio 2 Oasis Westmorland North	Calexico 2 NE El Centro 2 SSW Imperial Indio FS Mecca FS Niland
Yuma area	Yuma North Gila Yuma Mesa Yuma Valley	--	Yuma Proving Ground Yuma Quartermaster

*National Weather Station (NWS) stations collect precipitation data only.

Although the AZMET and CIMIS networks perform calculations of reference ET, it was discovered that there was a disparity in the values reported by each network for the lower Colorado River. Upon investigation, it was determined that the reason for the disparity was because the AZMET and CIMIS networks each use slightly different equations to calculate reference ET. Within the Parker and Palo Verde valleys, both CIMIS and AZMET stations are used to derive average reference ET values. By calculating reference ET using the standardized equation with the climatological data provided by the AZMET and CIMIS networks, this disparity is eliminated, and leaves only site conditions, equipment calibration, and micro-climatic differences between sites as sources of site to site variations in reference-ET values. Reclamation currently uses the reference ET values provided by the CIMIS network for the Imperial and Coachella valleys, and reference ET values from the AZMET network for the Wellton-Mohawk area.

Reclamation develops area-specific reference ET values for the Mohave Valley, the Parker/ Palo Verde Valleys, the Imperial/Coachella valleys, the Wellton-Mohawk area (when more than one station is available), and the Yuma Area by averaging reference ET values from multiple sites within these areas. Figure 5 shows the reference ET and precipitation values used to develop the 2009 ET rates, which are then used to calculate ET from crop and riparian vegetation groups.

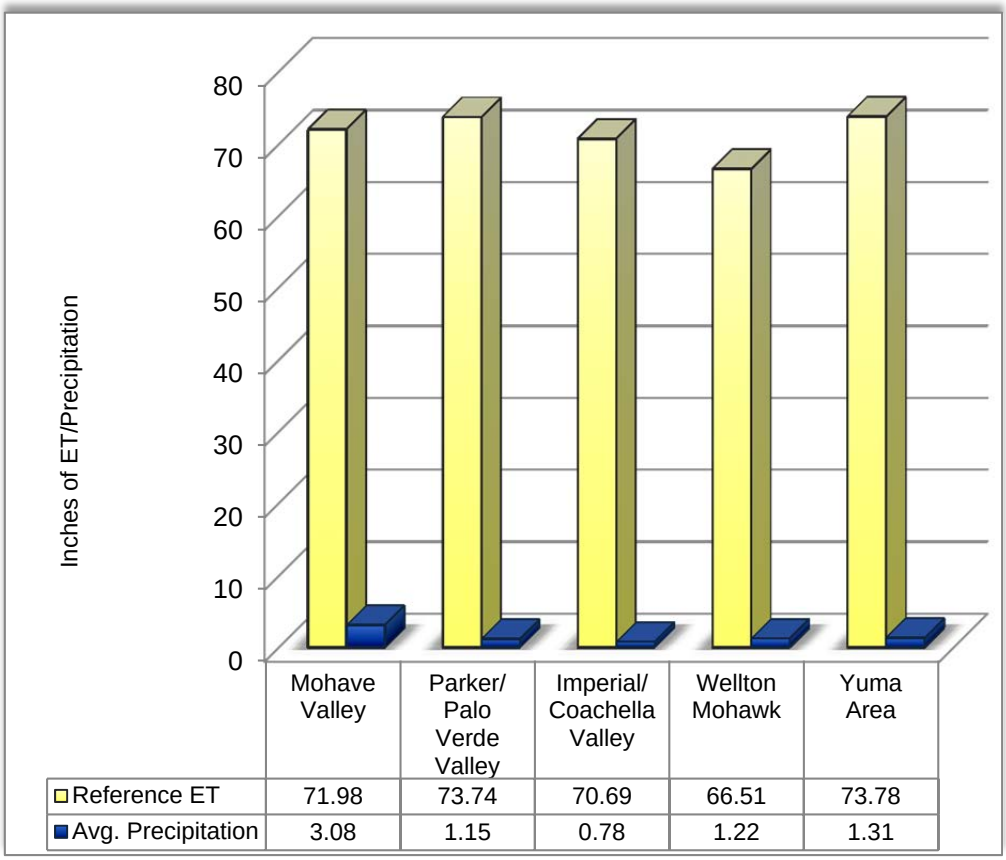

Figure 5. Reference ET and precipitation. Units: Inches.

3.2.2 ET Coefficients for Crop and Riparian Vegetation Groups

ET coefficients are the values that relate reference ET to the ET rate of a specific crop or riparian vegetation group, as well as to the evaporation rate from a water body. Jensen, Marvin E. (1998*), Coefficients for Vegetative Evapotranspiration and Open Water Evaporation for the Lower Colorado River Accounting System*, presents the rationale used to develop the original crop and riparian vegetation groups along the lower Colorado River and the Bill Williams River, their respective ET coefficients, and open water evaporation coefficients. Jensen, Marvin E. (2003), *Vegetative and Open Water Coefficients for the Lower Colorado River Accounting System (LCRAS), Addendum to the 1998 Report*, presents the adjustments made to the crop and riparian vegetation groups and the ET and evaporation coefficients, which are used in this report. The ET coefficients developed for the Yuma area are used to calculate crop ET for WMIDD.

The ET coefficients used for crops grown in IID and CVWD are derived from coefficients reported in Jensen, Marvin E. and Walter, Ivan A. (1997), *Assessment of 1987-1996 Water Use by the Imperial Irrigation District using Water Balance and Cropping Data Special Report, June 1997*. These ET coefficients were compared with crop ET coefficients for CVWD developed by Lord, J.M. (1994), reported in *Water Use Assessment, Coachella Valley Water District and*

Imperial Irrigation District, Phase I Report, and found to be similar; therefore the same ET coefficients are used for IID and CVWD. For a more in-depth description of the ET coefficients used for IID and CVWD, see *Lower Colorado River Accounting System Evapotranspiration and Evaporation Calculations, Calendar Year 2004.*

3.2.3 Calculating Effective Precipitation

Effective precipitation is that portion of precipitation which infiltrates and remains in the soil so as to be available for crop consumptive use. A correction to the ET rate for crop groups is required to remove the impact of precipitation so the ET calculated reflects only the consumptive use of Colorado River water. Reclamation calculates effective precipitation as the product of recorded precipitation and an effective precipitation coefficient. Precipitation is recorded by rain gauges located at CIMIS and AZMET stations, and at stations operated by NWS along the lower Colorado River. Table 3 provides a list of the stations used to collect the reference ET data used in Reclamation's calculations and the corresponding geographical areas for which each station's data are applied.

Reclamation developed a single daily, area-specific precipitation value for the Mohave Valley, the Parker/Palo Verde valleys, the Wellton-Mohawk area, the Imperial and Coachella valleys, and the Yuma area by averaging precipitation measured at the CIMIS, AZMET, and NWS stations in each area. Jensen, Marvin E. (1993), *Evaluating Effective Rainfall in CVWD,* contains the documentation for the effective precipitation coefficients used in this report. Reclamation uses the following equation to calculate effective precipitation:

Effective Precipitation = Daily Precipitation × Monthly Effective Precipitation Coefficient

Because the amount of precipitation in the lower Colorado River basin is typically very small, the correction to the ET rate for precipitation is also typically very small.

3.2.4 Calculating Crop ET

To calculate ET from crops in the program area, Reclamation calculates an ET rate (in inches) for each crop group by multiplying the average daily reference ET values (inches) by each group's unique daily ET coefficient (dimensionless). (See Appendix, Part 2 of the *Lower Colorado River Accounting System Evapotranspiration and Evaporation Calculations, Calendar Year2008* report for daily Kc values.) Reclamation considers the effect of rainfall on crop water use by subtracting effective precipitation (inches) from the ET rate for each crop group to yield a net ET rate (inches). Reclamation sums the daily ET rates to produce a monthly ET rate (inches) for each crop group.

Reclamation determines the acreage of each crop group within each water user's boundary using GIS technologies, RS, and field survey data as previously described. For multi-year crops that are present during only part of the year, such as alfalfa and orchards, Reclamation uses quarterly acreage estimates for the ET calculation.

Reclamation calculates the ET (in acre-feet) within each water user's boundary by multiplying the ET rate for each crop group by the acreage of each crop group. These calculations are performed on a monthly time-step and the results summed to produce annual agricultural ET values within each water user's boundary. The following equation is used to calculate ET for a specific crop group:

$$\text{Annual ET} = \sum_{t=0}^{n} \frac{[(ET_o \times K_c) - \text{Effective PPT}]\ AC}{12 \text{ inches/foot}}$$

Figure 6. AZMET weather station, Mohave 2, located in the Mohave Valley, AZ.

Where:

ET	=	Annual ET by crop group (acre-feet)
n	=	Time-step (monthly)
ET_o	=	Daily reference ET (inches)
K_c	=	Daily ET coefficient for a specific crop (dimensionless)
AC	=	Acres of crop
Effective PPT	=	Effective precipitation (inches)

3.2.5 Calculating ET from Riparian Vegetation

Reclamation calculates ET from riparian vegetation for this report the same way it calculates agricultural ET, except that no correction is made to the ET rates of riparian vegetation for effective precipitation. The sum of the ET from all riparian vegetation groups within a water user's boundary yields the riparian vegetation ET for that individual water user.

3.3 Calculating Evaporation from Open Water Areas

Reclamation calculates evaporation from open water areas within the program area using the following data:

1. Reference ET.
2. Evaporation coefficients.

3. Number of acres and location of the open water area.
4. Precipitation.

The following sections describe the methods utilized by Reclamation to calculate open water evaporation from the mainstream and from major delivery canals.

3.3.1 Mainstream

Reclamation calculates evaporation from Lakes Mohave and Havasu, and the open water areas of the mainstream Colorado River channel and its adjacent backwaters (such as Topock Marsh and Mittry Lake) from below Hoover Dam to Mexico. The following equation is used to calculate evaporation from open water areas:

$$\text{Annual EVAP} = \sum_{t=0}^{n} \frac{[(ET_o \times K_c)\text{-PPT}]\ AC}{12\ \text{inches/foot}}$$

Where:

EVAP	=	Annual Evaporation by open water (acre-feet)
n	=	Time-steps (monthly)
ET_o	=	Daily reference ET (inches)
K_c	=	Monthly Evaporation coefficient for water (dimensionless)
AC	=	Acres of water
PPT	=	Precipitation (inches)

Reclamation verified the open water area for this report using the method described in Section 3.1.5, “Delineating Open Water Areas.”

3.3.2 Calculating Evaporation from Major Delivery Canals

Reclamation calculates evaporation from the All American Canal, Gila Gravity Main Canal and other major delivery canals in the Yuma area using the same equation used to calculate evaporation from the mainstream. Reclamation categorized major delivery canals into two groups: (1) those that deliver water to a single water user (single-user canals) and, (2) those that deliver water to two or more water users (shared canals).

Evaporation from a shared canal is proportioned among the water users which receive water from the canal. Reclamation calculates each water user’s proportionate share of evaporation using the following process:

1. Calculate the distance from the canal headworks to the user’s point(s) of delivery. In cases where a user has more than one delivery point, Reclamation calculates a single

point of delivery using a weighted average based on the user's diversion amounts at each point of delivery. These values have units of miles.

2. Multiply the mileage value from (1) by the user's total diversion to derive what is referred to as the pro-rata factor. These values have units of acre-foot miles.
3. Divide the pro-rata factor for each water user (derived in (2)) by the sum of the pro-rata factors for all water users that receive water from the canal. This value, which can be expressed as fractions or percentages, represents each user's percentage use of the canal.
4. Multiply each user's percentage use of the canal by the total volume of evaporation from the canal to determine each user's share of evaporation from the canal.

4.0 Results

For each specified water user, Table 4 shows the ET from agriculture and riparian vegetation; and evaporation from the open water surfaces within that water user's boundary. As previously mentioned, areas with identified crops and/or riparian vegetation not located within a known water user boundary are mapped and labeled with the name of the state in which they are located. Table 4 includes water users which are not located on the river but are irrigated with water diverted from the Colorado River; specifically WMIDD in Arizona, and IID and CVWD in California.

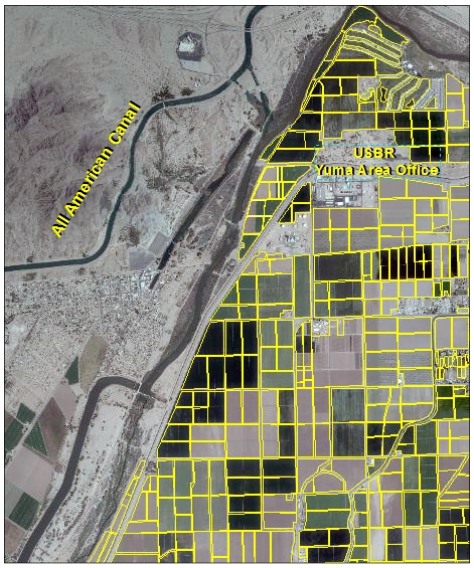

Figure 7. Digital image showing the All-American Canal, one of the canals from which Reclamation estimates evaporation.

Table 4. Agricultural ET, Riparian Vegetation ET, and Open Water Evaporation by Water User, Lower Colorado River, Hoover Dam to Mexico. Units: Annual Acre-Feet.

Water User	Agricultural ET	Riparian Vegetation ET[3]	Open Water Evaporation
Nevada (below Hoover Dam)			
Fort Mojave Indian Reservation	1,103	5,867	59
Lake Mead National Recreation Area (Davis Dam to Parker Dam)	0	93	209
Lake Mead National Recreation Area (Hoover Dam to Davis Dam)	0	180	2
State of Nevada	0	11,685	274
Nevada Totals*	**1,103**	**17,825**	**544**
California			
Bernal Farm	0	1,246	0
Chemehuevi Indian Reservation	10	50	0
Cibola National Wildlife Refuge	0	16,419	875
Clark Farm	0	133	0
Coachella Valley Water District	164,239	0	5,634
Colorado River Indian Reservation	0	34,482	389
Fort Mojave Indian Reservation	11,499	4,817	0
Fort Yuma Indian Reservation and Picacho State Recreation Area	0	43	0
Fort Yuma Indian Reservation and Yuma Proving Ground	0	663	1
Fort Yuma Indian Reservation	2,640	12,477	227
Havasu National Wildlife Refuge	0	5,404	1,159
Imperial Irrigation District	1,514,046	0	10,415
Imperial National Wildlife Refuge and Yuma Proving Ground	0	47	0
Imperial National Wildlife Refuge (Imperial Dam to Mexico)	0	29	0
Imperial National Wildlife Refuge (Parker Dam to Imperial Dam)	0	21,518	5,744
Moabi Regional Park	0	224	0
North Lyn-De Farm	833	0	0

[3] Riparian Vegetation ET is monitored only in the Colorado River floodplain.

Water User	Agricultural ET	Riparian Vegetation ET[3]	Open Water Evaporation
Palo Verde Irrigation District	291,372	8,288	778
Picacho State Recreation Area (Imperial Dam to Mexico)	0	1,104	11
Picacho State Recreation Area (Parker Dam to Imperial Dam)	0	5,030	516
South Lyn-De Farm	825	2	0
State of California (Other users Imperial Dam to Mexico)	4,754	2,669	233
State of California (Other users, Davis Dam to Parker Dam)	373	15,955	401
State of California (Other users, Parker Dam to Imperial Dam)	1,781	27,961	1,695
Yuma Project Reservation Division, Bard Unit	22,906	866	173
Yuma Project Reservation Division, Indian Unit	18,238	1,320	116
Yuma Proving Ground	0	8,193	22
California Totals*	**2,033,516**	**168,940**	**28,389**
Arizona			
Arkelian Farms	1,385	2,580	0
Bill Williams River National Wildlife Refuge	0	10,486	0
Cibola National Wildlife Refuge	10,642	36,846	2,923
Cibola Valley Irrigation and Drainage District	14,126	7,944	3
Colorado River Indian Reservation	352,517	130,768	1,158
East Cocopah Reservation	0	0	0
Ehrenberg Farm	3,335	1	0
Fort Mojave Indian Reservation	34,261	31,295	169
Fort Yuma Indian Reservation & Homesteads	1,626	2,798	44
Fort Yuma Indian Reservation, Mittry Lake State Wildlife Area and Yuma Proving Ground	0	829	182
Gila Monster Farms	5,562	773	114
Havasu National Wildlife Refuge	385	47,780	16,393
Havasu State Park (Windsor Beach)	0	3,079	0
Imperial National Wildlife Refuge (Imperial Dam to Mexico)	107	5,975	2,369
Imperial National Wildlife Refuge (Parker Dam to Imperial Dam)	200	34,070	6,538

Water User	Agricultural ET	Riparian Vegetation ET[3]	Open Water Evaporation
Lake Mead National Recreation Area (Davis Dam to Parker Dam)	0	327	313
Lake Mead National Recreation Area (Hoover Dam to Davis Dam)	0	486	17
Mittry Lake State Wildlife Area	177	10,107	498
Mohave Valley Irrigation and Drainage District	23,724	26,108	415
North Cocopah Indian Reservation	1,281	11	38
North Gila Valley Irrigation and Drainage District	20,220	1,994	55
Palo Verde Irrigation District	525	566	252
State of Arizona (Other users, Davis Dam to Parker Dam)	0	3,725	240
State of Arizona (Other users, Imperial Dam to Mexico)	10,366	12,033	380
State of Arizona (Other users, Parker Dam to Imperial Dam)	0	21,869	647
State of Arizona – Down gradient of the Yuma Mesa Irrigation and Drainage District	28,063	0	0
State of Arizona – Limitrophe Section	1,932	4,209	0
Unit “B” Irrigation and Drainage District	6,994	0	128
University of Arizona Agricultural Station	234	0	0
Wellton-Mohawk Irrigation and Drainage District	196,305	5	743
West Cocopah Indian Reservation	5,406	6,410	0
Yuma County Water Users’ Association	120,582	8	1,898
Yuma Irrigation District	32,479	711	379
Yuma Mesa Irrigation and Drainage District	65,934	0	1,040
Yuma Proving Ground	0	653	0
Arizona Totals*	**938,368**	**404,446**	**36,936**
Hoover Dam to Mexico Totals*	**2,972,987**	**591,211**	**65,869**

*Due to rounding, totals shown may differ from the sum of the individual values.

Table 5 provides a summary of ET and evaporation results along the lower Colorado River from Hoover Dam to Mexico. (Note: Bill Williams River NWR is included in the Davis Dam to Parker Dam reach; WMIDD, IDD, and CVWD are included in the Imperial Dam to Mexico reach.)

Table 5. Summary of ET and Evaporation along the Lower Colorado River from Hoover Dam to Mexico. Units: Annual Acre-Feet.

ET Category/Evaporation	Hoover Dam to Davis Dam	Davis Dam to Parker Dam	Parker Dam to Imperial Dam	Imperial Dam To Mexico	Total: Hoover Dam To Mexico*
Agricultural ET	0	71,353	677,540	2,224,090	2,972,983
Riparian Vegetation[3]	667	166,893	349,722	73,927	591,209
Evaporation – Open Water	20	19,632	21,516	24,702	65,870
Evaporation – Mainstream	135,666	99,426	52,259	5,692	293,043

*Due to rounding, totals shown may differ from the totals shown in Table 4.

Table 6 shows the ET from agriculture and riparian vegetation and evaporation from open water areas along the Bill Williams River,[4] the Gila River Valley[5], and South Yuma Mesa[6]. The origin of the water used for agricultural irrigation and by riparian vegetation in these areas is considered to come from sources other than the Colorado River.

Table 6. Agricultural ET, Riparian Vegetation ET, and Open Water Evaporation by Water User: Bill Williams River, Gila River Valley, and South Yuma Mesa. Units: Annual Acre-Feet.

Water User Name	Agricultural ET	Riparian Vegetation ET[3]	Open Water Evaporation
State of Arizona, Alamo Dam to Bill Williams National Wildlife Refuge	1,175	24,238	323
State of Arizona – Gila River Valley	7,022	21	0
Hillander C Irrigation District	7,262	0	0
Totals	**15,459**	**24,259**	**323**

Additional information on the water users identified in Tables 4 through 6, including agricultural acreage (irrigable, gross cropped, net cropped, and fallowed/idle acres), crop types and acreages, agricultural ET by crop type, riparian vegetation acreage and open water acreage has been included in Appendix 1. For select water users, the appendix also provides the historical five-year trend (calendar years 2004-2009) of the user's total diversions and consumptive use (as reported in Reclamation's 2009 *Colorado River Accounting and Water Use Report, Arizona*,

[4] Bill Williams River, from Alamo Dam to the eastern extent of the Colorado River aquifer.
[5] Agricultural land outside of WMIDD that is irrigated with wells pumping Gila River Valley ground water.
[6] Hillander C Irrigation District is located on the South Yuma Mesa and is irrigated with ground water not available for other users in the United States or to meet the 1944 Mexican Treaty obligation.

California, and Nevada), and agricultural ET (crop ET minus effective precipitation). It is important to note that the agricultural ET values presented in this report represent an estimate of the crop ET assuming a healthy crop and an adequate water supply and should not be confused with the consumptive use values reported in Reclamation's Water Accounting Reports, which are calculated as diversions less measured and unmeasured return flows.

5.0 Program Improvements for Calendar Year 2009

Reclamation annually reviews each application of the methodology and incorporates "lessons learned" into subsequent reports. Reclamation also modifies each application of the methodology in response to information provided by water users and as modified processes become available after analysis of long-term questions and issues.

The following paragraphs describe improvements to crop and riparian vegetation identification and ET calculations made since the issuance of the 2008 report, and potential future improvements.

5.1 Improving ET Estimates for Riparian Vegetation

Reclamation completed a cooperative study initiated in fiscal year 2001 with the Nevada Water Science Center of the USGS to improve estimates of ET from riparian vegetation. The study's objective, to refine ET estimates for the most common riparian vegetation communities found along the lower Colorado River using parameters measured by three micro-meteorological stations placed above riparian vegetation stands in Topock Marsh, is documented in, *Evapotranspiration by Phreatophytes Along the Lower Colorado River at Havasu National Wildlife Refuge, Arizona*. This report includes:

1. Estimates of ET from riparian vegetation.
2. A comparison of these estimates with estimates of ET from riparian vegetation calculated using ET coefficients and reference ET currently used by Reclamation.
3. A description of adjustments for the riparian vegetation ET coefficients used by Reclamation.

Reclamation expects the results of this study to be incorporated in future reports.

5.2 Adjusting Water User Boundaries

For calendar year 2009, minor adjustments to water user boundaries were made. These changes had no effective impact on ET calculations.

5.3 Refinement of Open Water Areas and Changes to Evaporation Calculations

Acreage of open water areas was revised using 1-m resolution 2009 NAIP for agricultural lands in California. This high-resolution imagery was not available in 2009 for agricultural lands in Arizona. In addition, 30-m resolution LANDSAT satellite imagery was used to identify areas of large (>1800m^2) changes in open water surface area not identifiable using 2009 NAIP imagery.

Evaporation calculations for open water surfaces along the main stem of the Lower Colorado River use unique evaporation coefficients for each geographical area (Jensen, 2003).

Beginning in 2009, evaporation from duck and fish ponds in the IID and CVWD areas is no longer included in open water evaporation calculations. Additionally, beginning in 2009, in calculating the portion of evaporation from the All-American Canal in the Yuma area that is attributed to IID and CVWD, Yuma-area weather data and Yuma-area evaporation coefficients were used.

6.0 References

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Jensen, Marvin E. 1993. *Evaluating Effective Rainfall in CVWD*. Appendix 3 of *Water Use Assessment, Coachella Valley Water District and Imperial Irrigation District, Phase I Report,* (Draft April 1994) from the Technical Work Group, Stephen M. Jones, Charles M. Burt, Albert J. Clemmens, Marvin E. Jensen, Joseph M. Lord, Jr., Kenneth H. Solomon. (See page A3-13.) (Copies of Appendix 3 are available from the Bureau of Reclamation, Boulder Canyon Operations Office, Boulder City, Nevada).

Jensen, Marvin E. 1997. *Assessment of 1987-1996 Water Use by the Imperial Irrigation District using Water Balance and Cropping Data Special Report June 1997*. (Copies available from the Bureau of Reclamation, Boulder Canyon Operations Office, Boulder City, Nevada).

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Appendix 1: Water User Fact Sheets

This appendix is intended to supplement the information contained in Table 4, and includes the following information for each water user: agricultural acreage (irrigable acres, gross cropped acres, net cropped acres and fallowed/idle acres); crop types and acreages; agricultural ET by crop type; riparian vegetation acreage and ET; and open water acreage and evaporation. For select users, the appendix also provides a historical 5-year trend (calendar years 2004-2009) of the user's total Colorado River diversions and consumptive use (diversions less measured and unmeasured return flows) – as reported in Reclamation's annual Colorado River Accounting and Water Use Report: Arizona, California, and Nevada – and agricultural ET (crop ET minus effective precipitation – as reported in Reclamation's annual Estimates of Evapotranspiration and Evaporation Along the Lower Colorado River, formerly LCRAS, reports. Copies of these reports may be found on Reclamation's website at: www.usbr.gov/lc/region/g4000/wtracct.html.

Hoover Dam to Davis Dam

2009

Agriculture

There is no agricultural use in this reach.

Riparian

Riparian Vegetation Acres:	297
Riparian Evapotranspiration (acre-feet):	667

Open Water

Open Water Acres:	4
Open Water Evaporation (acre-feet):	20

Mainstream (Lake and River)

Acres:	27,356
Evaporation (acre-feet):	135,666

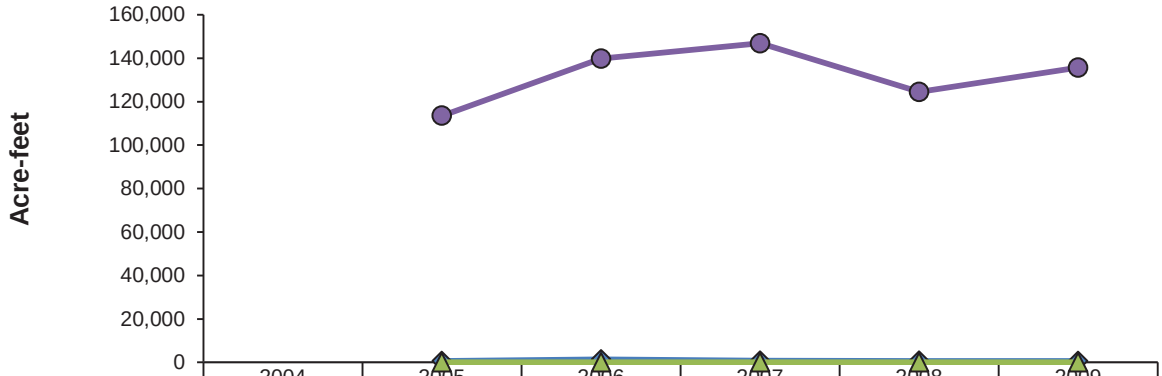
Water Users within Reach

Lake Mead National Recreation Area - AZ & NV

Crop Types within Reach | Acres | Annual ET (acre-feet)

Note: There are no crops in this reach.

Evapotranspiration and Evaporation, 2004-2009



	2004	2005	2006	2007	2008	2009
Riparian Vegetation ET	-	676	1,411	772	694	667
Open Water Evaporation	-	0	15	16	14	20
Mainstream Evaporation	-	113,520	139,744	146,810	124,469	135,666

Davis Dam to Parker Dam

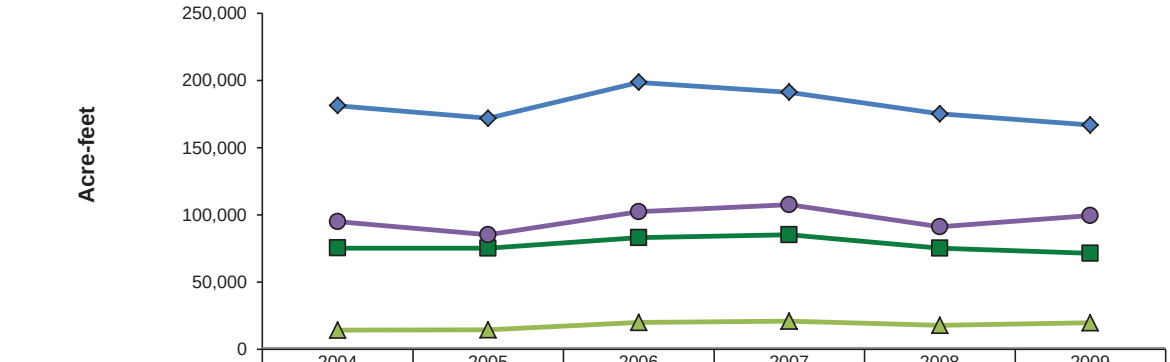
2009

Agriculture	
Irrigable Acres:	18,168
Gross Cropped Acres:	17,309
Net Cropped Acres:	17,303
Fallowed/Idle Acres:	865
Agricultural Evapotranspiration (acre-feet):	71,353
Riparian	
Riparian Vegetation Acres:	44,227
Riparian Evapotranspiration (acre-feet):	166,893
Open Water	
Open Water Acres:	3,959
Open Water Evaporation (acre-feet):	19,632
Mainstream (Lake and River)	
Acres:	20,049
Evaporation (acre-feet):	99,426

Water Users within Reach
Bill Williams River National Wildlife Refuge - AZ
Chemehuevi Indian Reservation - CA
Fort Mojave Indian Reservation - AZ, CA, & NV
Havasu National Wildlife Refuge - AZ & CA
Havasu State Park (Windsor Beach) - AZ
Lake Mead National Recreation Area - AZ & NV
Moabi Regional Park - CA
Mohave Valley Irrigation & Drainage District - AZ
State of AZ (Other Users)
State of AZ, Alamo Dam to Bill Williams NWR - AZ*
State of CA (Other Users)
State of NV (Other Users)

Crop Types within Reach	Acres	Annual ET (acre-feet)
Alfalfa	9,346	50,509
Bermuda	1,209	3,742
Cotton	4,999	13,376
Deciduous Orchards	9	42
Field Grain	104	253
Small Grains	1,606	3,356
Spring Melons	36	74
Total	**17,309**	**71,353**

Evapotranspiration and Evaporation, 2004-2009



	2004	2005	2006	2007	2008	2009
Agricultural ET	75,320	75,189	83,063	85,223	75,210	71,353
Riparian Vegetation ET	181,298	171,840	198,698	191,328	175,194	166,893
Open Water Evaporation	14,186	14,513	19,915	20,914	17734	19,632
Mainstream Evaporation	94,891	85,208	102,331	107,586	91,214	99,426

*The origin of water used for agricutural irrigation and by riparian vegetation and open water areas is considered to be from sources other than the Colorado River and therefore not included in reach calculations.

Parker Dam to Imperial Dam

2009

Agriculture	
Irrigable Acres:	174,121
Gross Cropped Acres:	141,288
Net Cropped Acres:	144,735
Fallowed/Idle Acres:	29,386
Agricultural Evapotranspiration (acre-feet):	677,540
Riparian	
Riparian Vegetation Acres:	86,857
Riparian Evapotranspiration (acre-feet):	349,722
Open Water	
Open Water Acres:	3,929
Open Water Evaporation (acre-feet):	21,516
Mainstream (Lake and River)	
Acres:	9,543
Evaporation (acre-feet):	52,259

Water Users within Reach
Arkelian Farm - AZ
Bernal Farm - CA
Cibola National Wildlife Refuge - AZ & CA
Cibola Valley Irrigation & Drainage District - AZ
Clark Farm - CA
Colorado River Indian Reservation - AZ & CA
Ehrenberg Farm, AZ
Imperial National Wildlife Refuge - AZ & CA
North Lyn-de Farm - CA
Palo Verde Irrigation District - AZ & CA
Picacho State Recreation Area - CA
South Lyn-de Farm - CA
State of AZ (Other Users)
State of CA (Other Users)

Crop Types within Reach	Acres	Annual ET (acre-feet)
Alfalfa	102,112	573,630
Bermuda	6,318	21,145
Citrus - Declining	4	10
Citrus - Mature	1,706	6,311
Citrus - Young	260	576
Cotton	7,148	21,195
Crucifers	1,487	1,551
Dates	328	1,951
Deciduous Orchards	1,146	5,564
Fall Lettuce	414	212
Fall Melons	386	496
Field Grain	1,237	3,086
Grapes	129	402
Moist Soil Unit	326	1,708
Perennial Vegetables	655	3,083
Small Grains	11,754	23,339
Small Vegetables	1,172	1,814
Spring Lettuce	499	347
Spring Melons	2,617	5,428
Sudan	1,589	5,690
Total	**141,288**	**677,540**

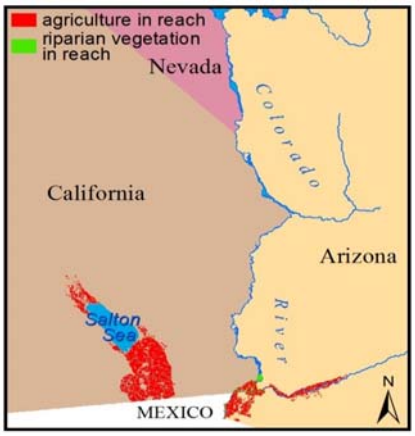
Evapotranspiration and Evaporation, 2004-2009

	2004	2005	2006	2007	2008	2009
Agricultural ET	706,754	673,839	705,987	721,465	724,704	677,540
Riparian Vegetation ET	383,807	367,513	354,312	366,439	363,385	349,722
Open Water Evaporation	4,943	5,264	23,269	25,030	23,711	21,516
Mainstream Evaporation	65,878	58,830	47,713	50,096	46,914	52,259

Imperial Dam to Mexico

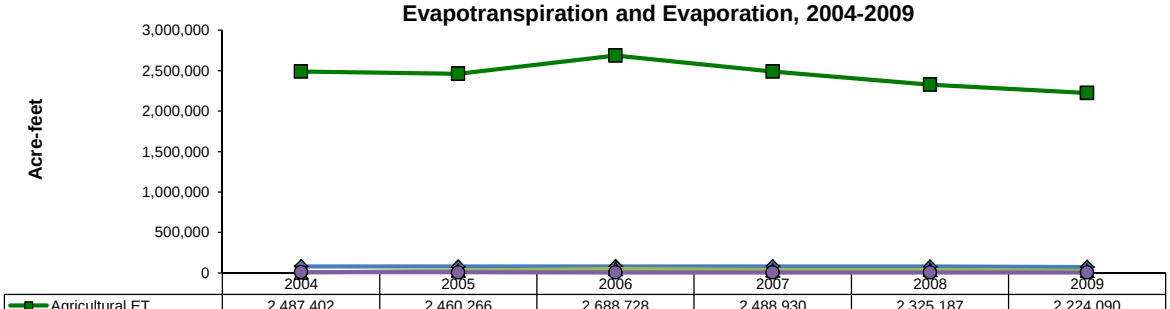
2009

Agriculture	
Irrigable Acres:	654,437
Gross Cropped Acres:	777,218
Net Cropped Acres:	610,256
Fallowed/Idle Acres:	44,182
Agricultural Evapotranspiration (acre-feet):	2,224,090
Riparian	
Riparian Vegetation Acres:	18,781
Riparian Evapotranspiration (acre-feet):	73,927
Open Water	
Open Water Acres:	4,020
Open Water Evaporation (acre-feet):	24,702
Mainstream (Lake and River)	
Acres:	932
Evaporation (acre-feet):	5,692



Water Users within Reach	Crop Types within Reach	Acres	Annual ET (acre-feet)
Coachella Valley Water District - CA	Alfalfa	153,531	770,572
Cocopah Indian Reservation (East, West & North) - AZ	Bermuda/Grass	68,752	291,332
Fort Yuma Indian Reservation & Picacho State Recreation Area - CA	Cane/Bamboo	384	2,164
Fort Yuma Indian Reservation & Yuma Proving Ground - CA	Citrus - Declining	793	2,041
Fort Yuma Indian Reservation & Homesteads - AZ	Citrus - Mature	20,513	74,376
Fort Yuma Indian Reservation, Bard Unit - CA	Citrus - Young	2,968	6,416
Fort Yuma Indian Reservation - CA	Cotton	13,503	43,064
Fort Yuma Indian Reservation, Indian Unit - CA	Crucifers	37,272	40,265
Fort Yuma Indian Reservation, Mittry State Wildlife Area & YPG -AZ	Dates	12,252	70,117
Gila Monster Farms - AZ	Deciduous Orchards	718	3,167
Hillander C Irrigation District - AZ*	Fall Lettuce	68,456	68,924
Imperial Irrigation District - CA	Fall Melons	1,456	1,783
Imperial National Wildlife Refuge - AZ & CA	Field Grain	13,924	37,670
Imperial National Wildlife Refuge and Yuma Proving Ground - CA	Grapes	8,086	23,691
Mittry Lake State Wildlife Area - AZ	Legume/Solanum Veg.	11,302	16,653
North Gila Valley Irrigation & Drainage District - AZ	Miscellaneous herbs	880	1,787
State of AZ (Other Users)	Moist Soil Unit	1,316	6,654
State of AZ - Wellton Mohawk Area - AZ*	Oil Crops	839	2,105
State of AZ - Down Gradient from YMIDD	Perennial Vegetables	1,300	5,843
State of AZ - Limitrophe Section	Root Vegetables	34	23
State of CA (Other Users)	Small Grains	167,448	343,359
Unit "B" Irrigation & Drainage District - AZ	Small Vegetables	44,746	93,086
University of Arizona Agricultural Station - AZ	Spring Lettuce	54,205	47,232
Yuma County Water Users Association - AZ	Spring Melons	9,747	17,298
Yuma Irrigation District - AZ	Sudan	61,915	194,729
Yuma Mesa Irrigation & Drainage District - AZ	Sugar Beets (Summer)	20,546	59,015
Yuma Proving Ground - AZ & CA	Tomatoes	334	723
Wellton-Mohawk Irrigation & Drainage District - AZ	**Total**	**777,218**	**2,224,090**

Evapotranspiration and Evaporation, 2004-2009



	2004	2005	2006	2007	2008	2009
Agricultural ET	2,487,402	2,460,266	2,688,728	2,488,930	2,325,187	2,224,090
Riparian Vegetation ET	82,031	78,676	80,456	80,648	78,567	73,927
Open Water Evaporation	5,971	28,650	48,889	34,898	35,937	24,702
Mainstream Evaporation	10,148	7,222	5,426	5,495	4,780	5,692

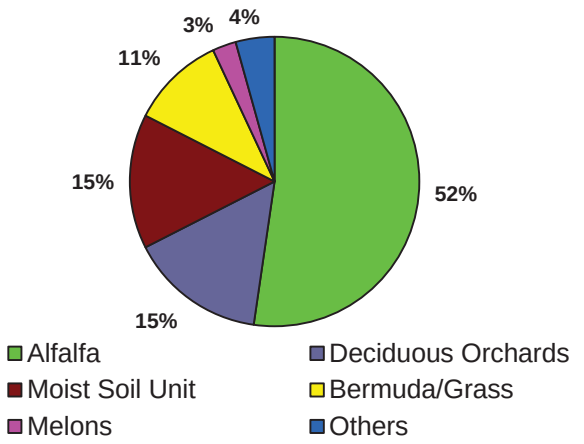
*The origin of water used for agricutural irrigation and by riparian vegetation and open water areas is considered to be from sources other than the Colorado River and therefore not included in reach calculations.

Cibola National Wildlife Refuge - AZ

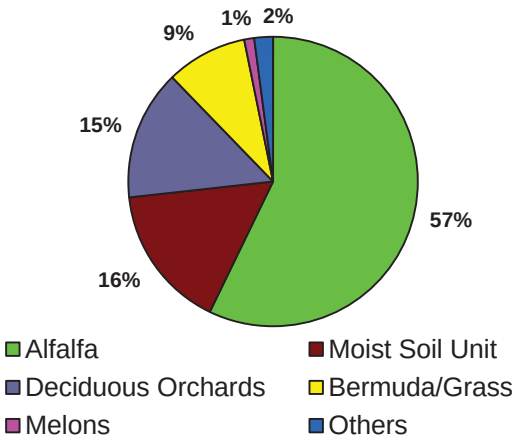
2009

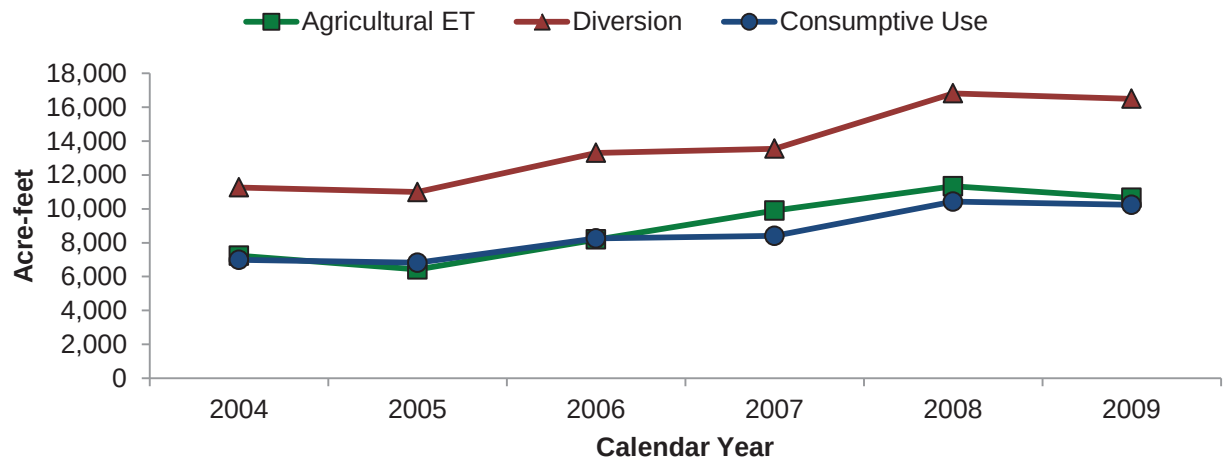
River Reach:	Parker Dam to Imperial Dam
Agriculture	
Irrigable Acres:	2,337
Gross Cropped Acres:	2,171
Net Cropped Acres:	2,272
Fallowed/Idle Acres:	65
Agricultural Evapotranspiration (acre-feet):	10,642
Riparian	
Riparian Vegetation Acres:	9,270
Riparian Evapotranspiration (acre-feet):	36,846
Open Water	
Open Water Acres:	534
Open Water Evaporation (acre-feet):	2,923

Major Crop Types



Annual Agricultural ET





Cibola National Wildlife Refuge - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	1,136	52	6,087	57
Bermuda/Grass	228	11	963	9
Cotton	19	<1	55	<1
Deciduous Orchards	330	15	1,543	14
Field Grain	34	2	84	<1
Moist Soil Unit	326	15	1,708	16
Small Grains	42	2	84	<1
Spring Melons	57	3	118	1
Total*	**2,171**	**100%**	**10,642**	**100%**

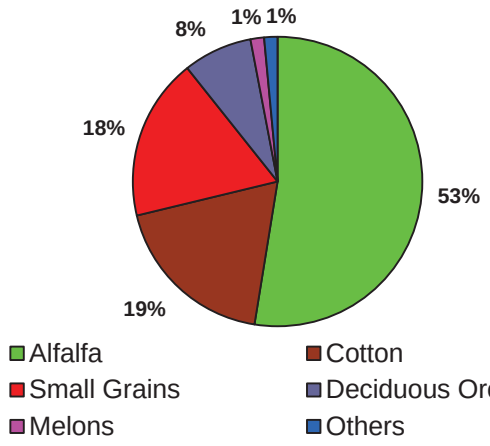
*Due to rounding, totals may differ from the sum of the individual values.

Cibola Valley Irrigation and Drainage District - AZ

2009

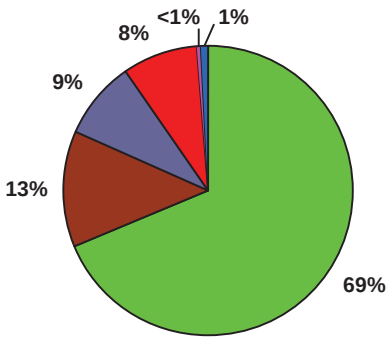
River Reach:	Parker Dam to Imperial Dam
Agriculture	
Irrigable Acres:	3,760
Gross Cropped Acres:	3,301
Net Cropped Acres:	3,453
Fallowed/Idle Acres:	308
Agricultural Evapotranspiration (acre-feet):	14,126
Riparian	
Riparian Vegetation Acres:	1,832
Riparian Evapotranspiration (acre-feet):	7,944
Open Water	
Open Water Acres:	1
Open Water Evaporation (acre-feet):	3

Major Crop Types

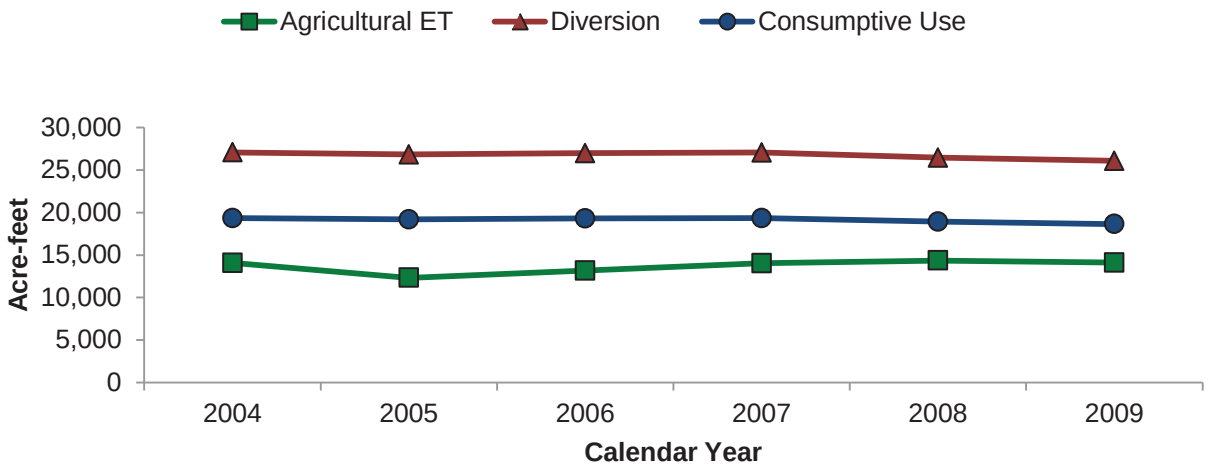


Alfalfa
Cotton
Small Grains
Deciduous Orchards
Melons
Others

Annual Agricultural ET



Alfalfa
Cotton
Deciduous Orchards
Small Grains
Melons
Others



Cibola Valley Irrigation and Drainage District - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	1,735	53	9,706	69
Bermuda/Grass	18	<1	60	<1
Cotton	616	19	1,828	13
Deciduous Orchards	255	8	1,230	9
Fall Melons	50	2	64	<1
Field Grain	18	<1	44	<1
Small Grains	596	18	1,184	8
Spring Lettuce	14	<1	10	<1
Total*	**3,301**	**100%**	**14,126**	**100%**

*Due to rounding, totals may differ from the sum of the individual values.

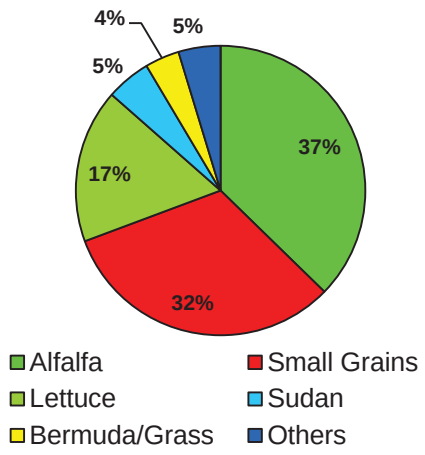
Cocopah Indian Reservation - AZ

(Includes East, North and West Reservations)

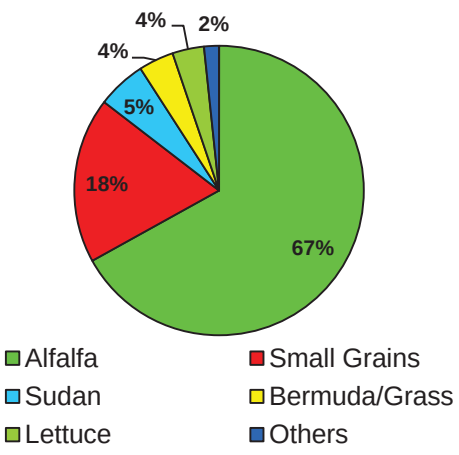
2009

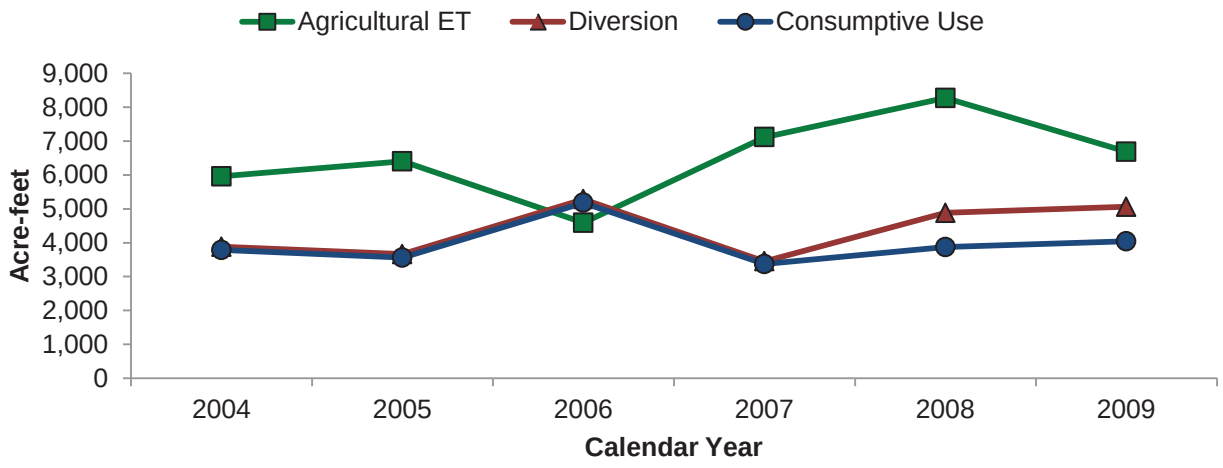
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	1,903
Gross Cropped Acres:	2,073
Net Cropped Acres:	1,886
Fallowed/Idle Acres:	17
Agricultural Evapotranspiration (acre-feet):	6,687
Riparian	
Riparian Vegetation Acres:	1,507
Riparian Evapotranspiration (acre-feet):	6,421
Open Water	
Open Water Acres:	6
Open Water Evaporation (acre-feet):	38

Major Crop Types



Annual Agricultural ET





Cocopah Indian Reservation - AZ

(Includes East, North and West Reservations)

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	774	37	4,476	67
Bermuda/Grass	80	4	262	4
Crucifers	44	2	45	<1
Fall Lettuce	188	9	141	2
Legume/Solanum Veg.	53	3	67	<1
Small Grains	664	32	1,237	19
Spring Lettuce	168	8	95	1
Sudan	103	5	364	5
Total*	**2,073**	**100%**	**6,687**	**100%**

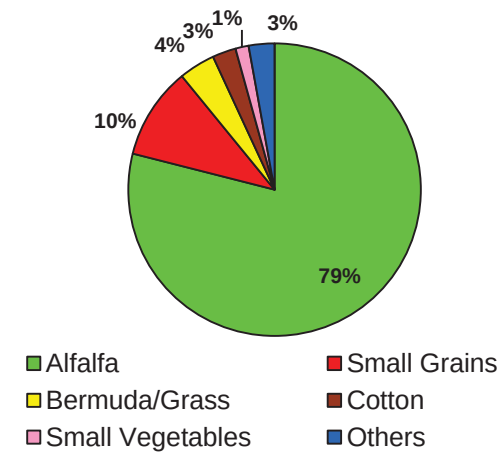
*Due to rounding, totals may differ from the sum of the individual values.

Colorado River Indian Reservation - AZ

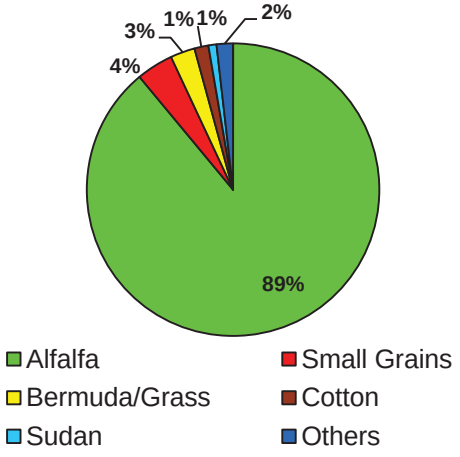
2009

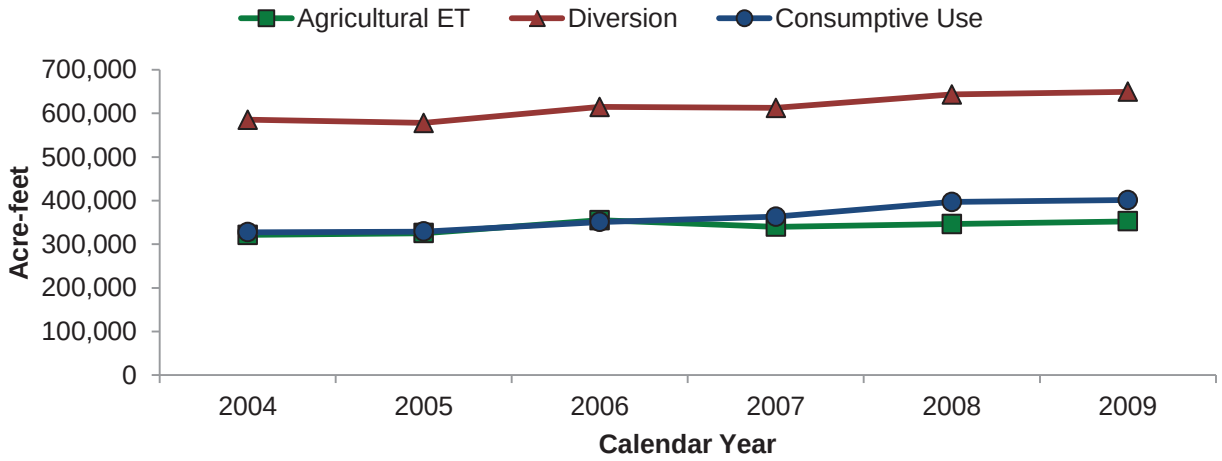
River Reach:	Parker Dam to Imperial Dam
Agriculture	
Irrigable Acres:	75,045
Gross Cropped Acres:	71,156
Net Cropped Acres:	71,660
Fallowed/Idle Acres:	3,385
Agricultural Evapotranspiration (acre-feet):	352,517
Riparian	
Riparian Vegetation Acres:	32,831
Riparian Evapotranspiration (acre-feet):	130,768
Open Water	
Open Water Acres:	211
Open Water Evaporation (acre-feet):	1,158

Major Crop Types



Annual Agricultural ET





Colorado River Indian Reservation - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	56,187	79	313,667	89
Bermuda/Grass	2,848	4	9,534	3
Cotton	1,837	3	5,447	2
Crucifers	70	<1	73	<1
Deciduous Orchards	319	<1	1,540	<1
Fall Lettuce	64	<1	33	<1
Field Grain	3	<1	7	<1
Grapes	5	<1	15	<1
Perennial Vegetables	655	<1	3,083	<1
Small Grains	7,217	10	14,329	4
Small Vegetables	1,042	1	1,613	<1
Spring Lettuce	30	<1	21	<1
Sudan	881	1	3,155	<1
Total*	**71,156**	**100%**	**352,517**	**100%**

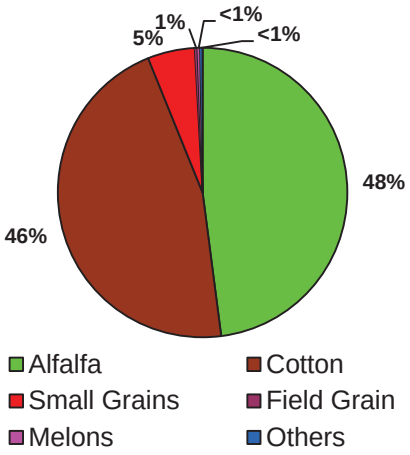
*Due to rounding, totals may differ from the sum of the individual values.

Fort Mojave Indian Reservation - AZ

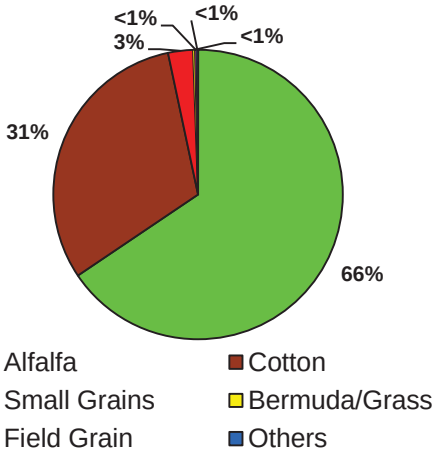
2009

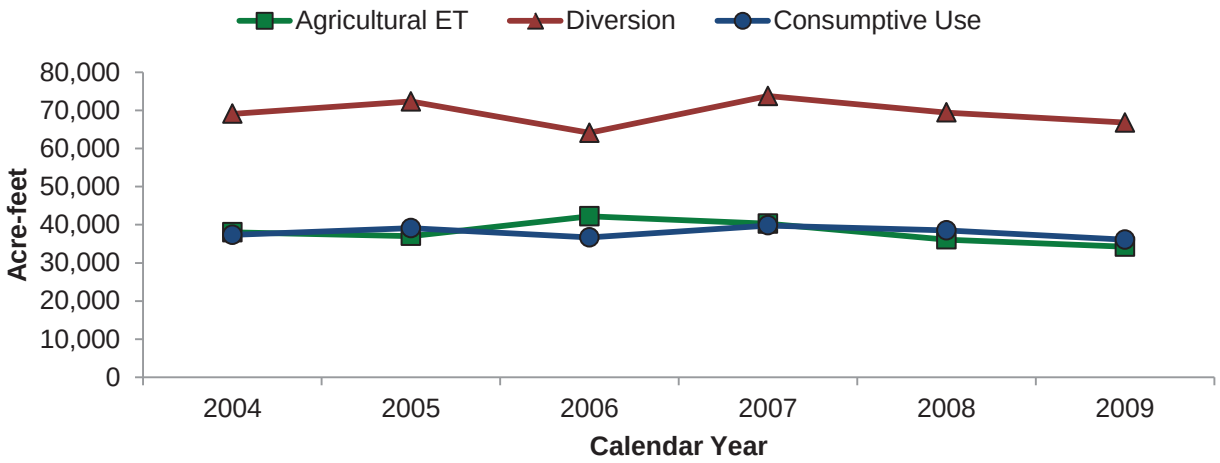
River Reach:	Davis Dam to Parker Dam
Agriculture	
Irrigable Acres:	8,798
Gross Cropped Acres:	8,674
Net Cropped Acres:	8,651
Fallowed/Idle Acres:	147
Agricultural Evapotranspiration (acre-feet):	34,261
Riparian	
Riparian Vegetation Acres:	8,042
Riparian Evapotranspiration (acre-feet):	31,295
Open Water	
Open Water Acres:	34
Open Water Evaporation (acre-feet):	169

Major Crop Types



Annual Agricultural ET





Fort Mojave Indian Reservation - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	4,158	48	22,460	66
Bermuda/Grass	24	<1	71	<1
Cotton	3,983	46	10,659	31
Field Grain	26	<1	62	<1
Small Grains	457	5	955	3
Spring Melons	26	<1	52	<1
Total*	**8,674**	**100%**	**34,261**	**100%**

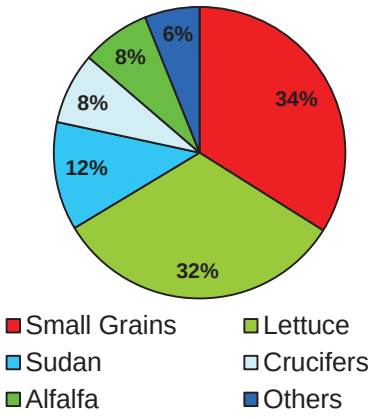
*Due to rounding, totals may differ from the sum of the individual values.

Gila Monster Farms - AZ

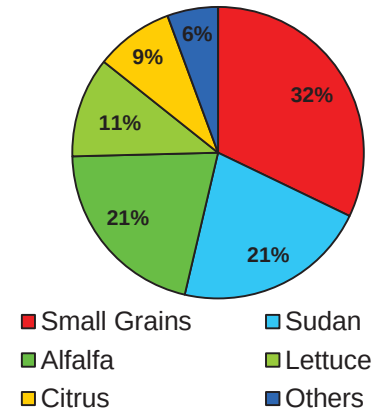
2009

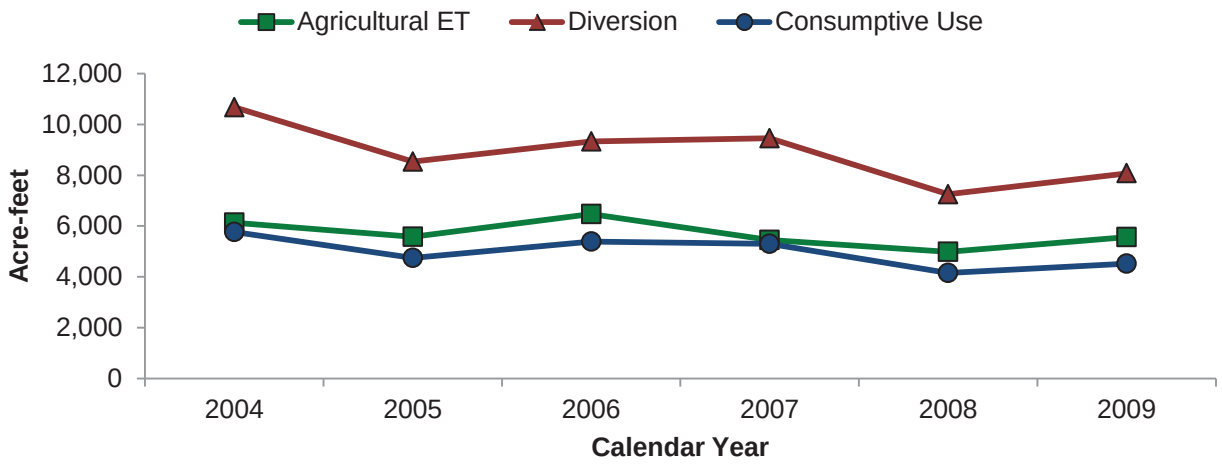
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	1,707
Gross Cropped Acres:	2,827
Net Cropped Acres:	1,695
Fallowed/Idle Acres:	13
Agricultural Evapotranspiration (acre-feet):	5,562
Riparian	
Riparian Vegetation Acres:	147
Riparian Evapotranspiration (acre-feet):	773
Open Water	
Open Water Acres:	19
Open Water Evaporation (acre-feet):	114

Major Crop Types



Annual Agricultural ET





Gila Monster Farms - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	215	8	1,164	21
Bermuda/Grass	8	<1	28	<1
Citrus - Mature	116	4	431	8
Citrus - Young	23	<1	51	<1
Cotton	7	<1	25	<1
Crucifers	224	8	228	4
Fall Lettuce	540	19	405	7
Small Grains	959	34	1,788	32
Small Vegetables	13	<1	25	<1
Spring Lettuce	377	13	213	4
Spring Melons	4	<1	8	<1
Sudan	339	12	1,197	22
Total*	**2,827**	**100%**	**5,562**	**100%**

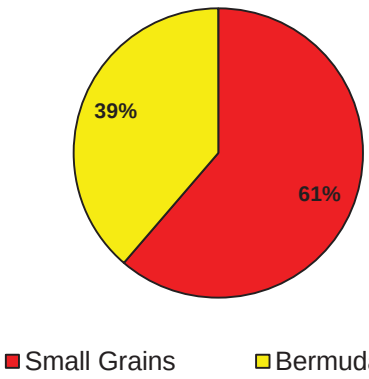
*Due to rounding, totals may differ from the sum of the individual values.

Havasu National Wildlife Refuge - AZ

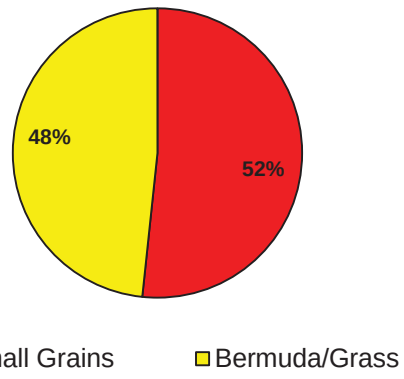
2009

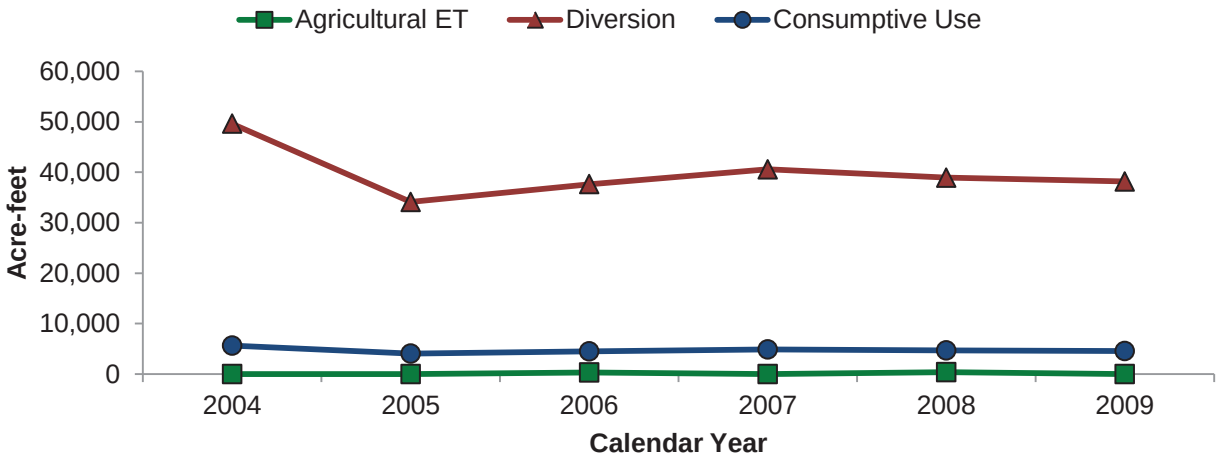
River Reach:	Davis Dam to Parker Dam
Agriculture	
Irrigable Acres:	155
Gross Cropped Acres:	155
Net Cropped Acres:	155
Fallowed/Idle Acres:	-
Agricultural Evapotranspiration (acre-feet):	385
Riparian	
Riparian Vegetation Acres:	10,754
Riparian Evapotranspiration (acre-feet):	47,780
Open Water	
Open Water Acres:	3,306
Open Water Evaporation (acre-feet):	16,393

Major Crop Types



Annual Agricultural ET





Havasu National Wildlife Refuge - AZ

2009

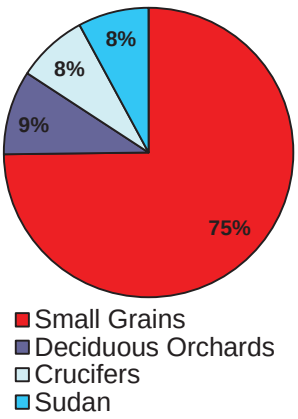
Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Bermuda/Grass	60	39	186	48
Small Grains	95	61	199	52
Total	**155**	**100%**	**385**	**100%**

Imperial National Wildlife Refuge - AZ

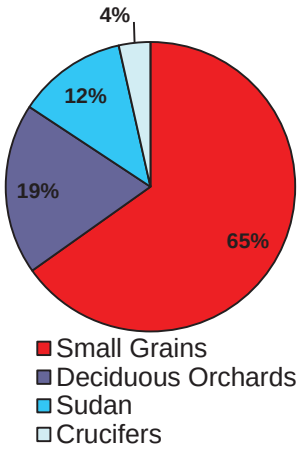
2009

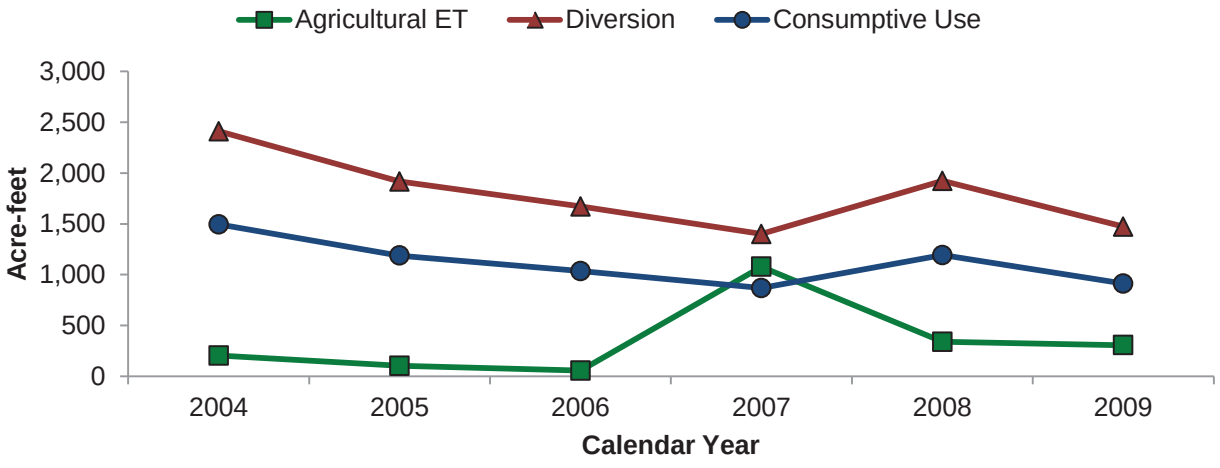
River Reach:	Parker Dam to Mexico
Agriculture	
Irrigable Acres:	23
Gross Cropped Acres:	135
Net Cropped Acres:	23
Fallowed/Idle Acres:	-
Agricultural Evapotranspiration (acre-feet):	307
Riparian	
Riparian Vegetation Acres:	8,937
Riparian Evapotranspiration (acre-feet):	40,045
Open Water	
Open Water Acres:	1,582
Open Water Evaporation (acre-feet):	8,907

Major Crop Types



Annual Agricultural ET





Imperial National Wildlife Refuge - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Crucifers	11	8	11	4
Deciduous Orchards	13	9	59	19
Small Grains	101	75	200	65
Sudan	11	8	37	12
Total*	**135**	**100%**	**307**	**100%**

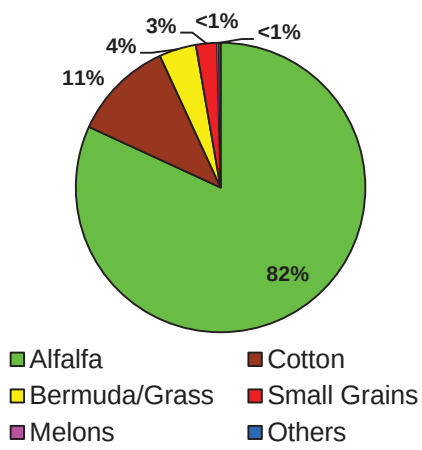
*Due to rounding, totals may differ from the sum of the individual values.

Mohave Valley Irrigation and Drainage District - AZ

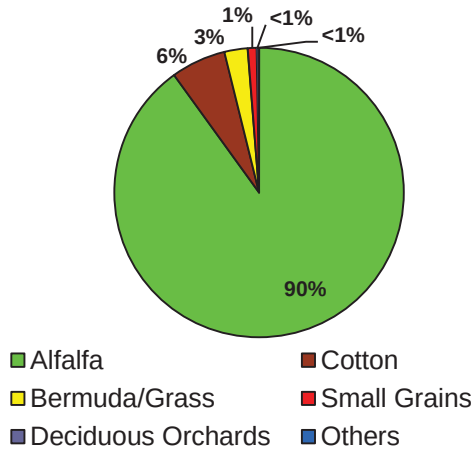
2009

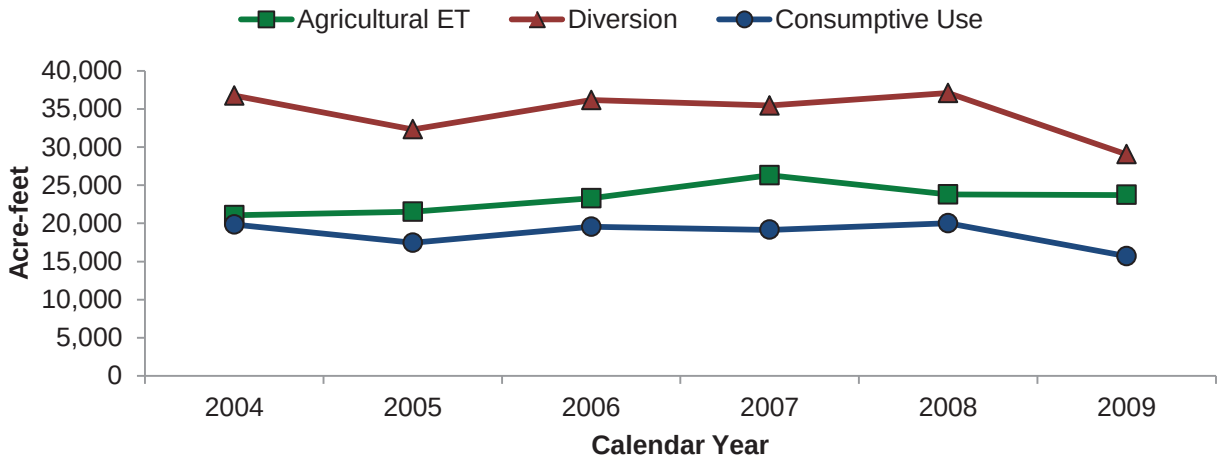
River Reach:	Davis Dam to Parker Dam
Agriculture	
Irrigable Acres:	5,165
Gross Cropped Acres:	4,817
Net Cropped Acres:	4,844
Fallowed/Idle Acres:	320
Agricultural Evapotranspiration (acre-feet):	23,724
Riparian	
Riparian Vegetation Acres:	6,753
Riparian Evapotranspiration (acre-feet):	26,108
Open Water	
Open Water Acres:	84
Open Water Evaporation (acre-feet):	415

Major Crop Types



Annual Agricultural ET





Mohave Valley Irrigation and Drainage District - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	3,944	82	21,358	90
Bermuda/Grass	199	4	617	3
Cotton	542	11	1,450	6
Deciduous Orchards	9	<1	42	<1
Small Grains	112	2	235	<1
Spring Melons	10	<1	21	<1
Total*	**4,817**	**100%**	**23,724**	**100%**

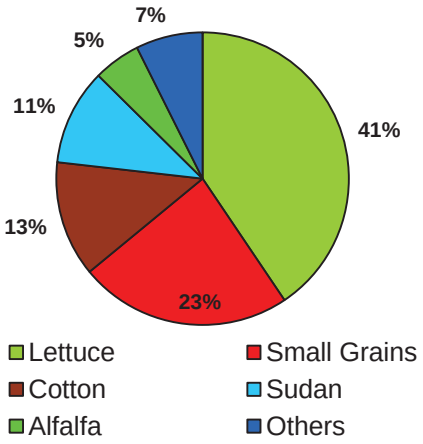
*Due to rounding, totals may differ from the sum of the individual values.

North Gila Valley Irrigation and Drainage District - AZ

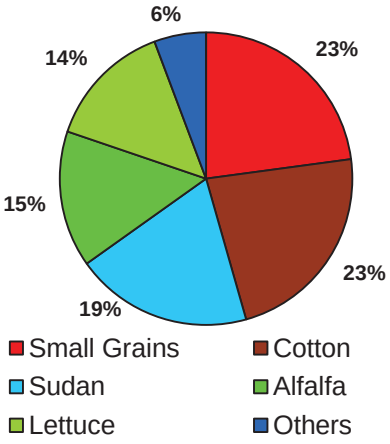
2009

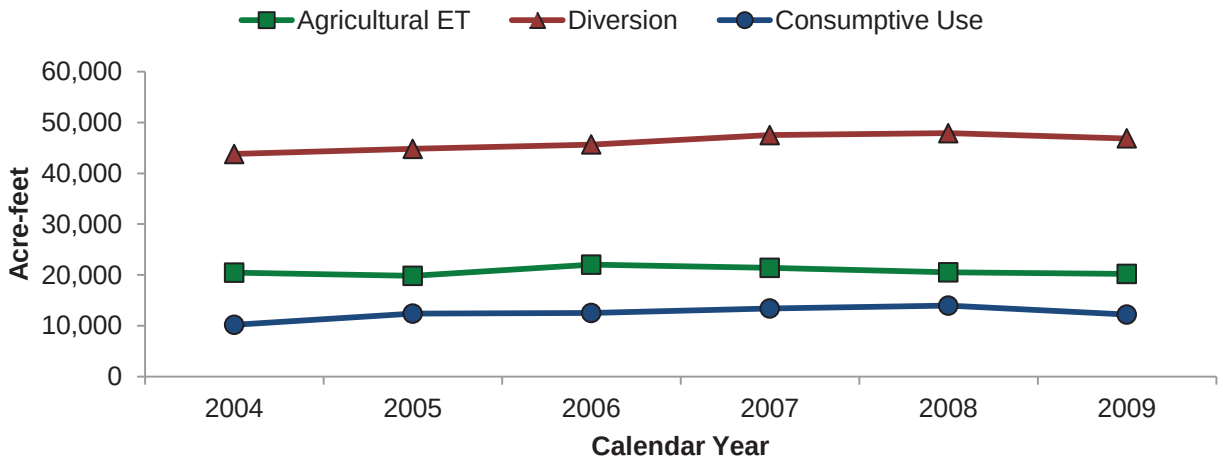
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	5,847
Gross Cropped Acres:	10,569
Net Cropped Acres:	5,780
Fallowed/Idle Acres:	67
Agricultural Evapotranspiration (acre-feet):	20,220
Riparian	
Riparian Vegetation Acres:	459
Riparian Evapotranspiration (acre-feet):	1,994
Open Water	
Open Water Acres:	9
Open Water Evaporation (acre-feet):	55

Major Crop Types



Annual Agricultural ET





North Gila Valley Irrigation and Drainage District - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	551	5	3,044	15
Bermuda/Grass	15	<1	50	<1
Citrus - Mature	14	<1	53	<1
Cotton	1,350	13	4,596	23
Crucifers	413	4	420	2
Dates	10	<1	64	<1
Fall Lettuce	2,288	22	1,714	8
Fall Melons	14	<1	16	<1
Legume/Solanum Veg.	42	<1	53	<1
Small Grains	2,480	23	4,623	23
Small Vegetables	118	1	228	1
Spring Lettuce	1,998	19	1,129	6
Spring Melons	153	1	273	1
Sudan	1,121	11	3,957	20
Total*	**10,569**	**100%**	**20,220**	**100%**

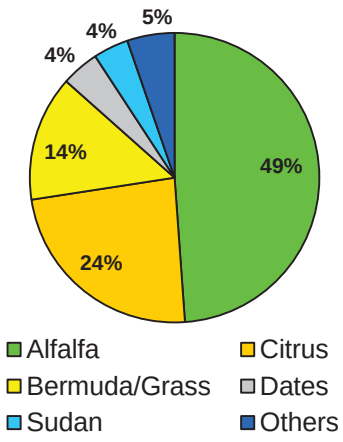
*Due to rounding, totals may differ from the sum of the individual values.

Unit B Irrigation and Drainage District - AZ

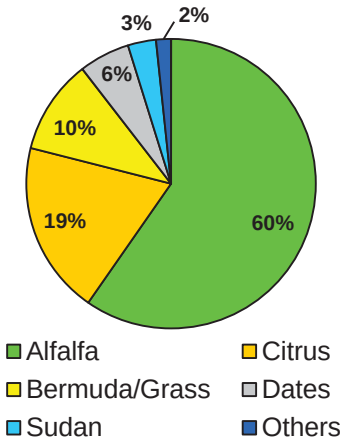
2009

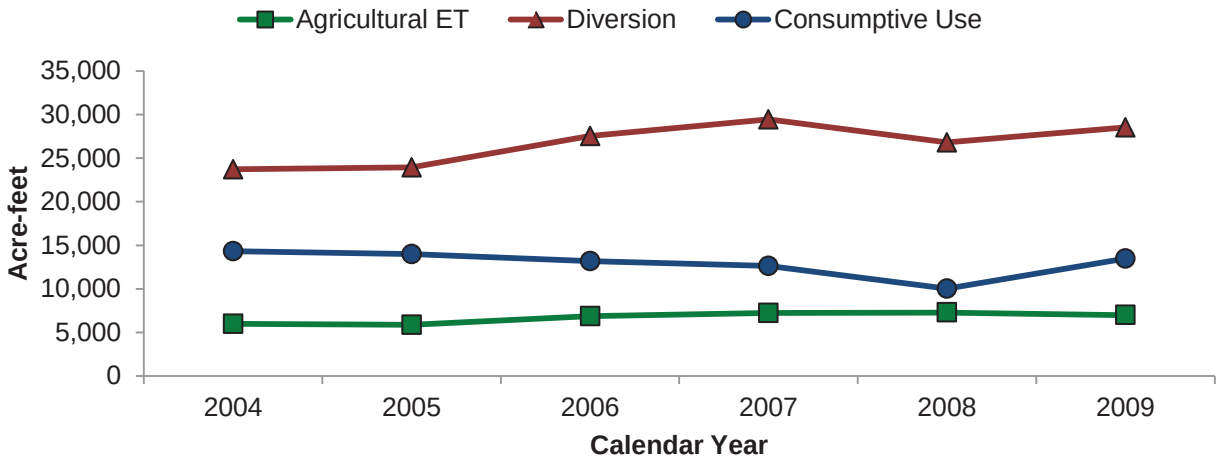
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	1,881
Gross Cropped Acres:	1,585
Net Cropped Acres:	1,587
Fallowed/Idle Acres:	294
Agricultural Evapotranspiration (acre-feet):	6,994
Riparian	
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-
Open Water	
Open Water Acres:	21
Open Water Evaporation (acre-feet):	128

Major Crop Types



Annual Agricultural ET





Unit B Irrigation and Drainage District - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	774	49	4,174	60
Bermuda/Grass	222	14	738	11
Citrus - Declining	21	1	54	<1
Citrus - Mature	337	21	1,254	18
Citrus - Young	18	1	41	<1
Dates	67	4	397	6
Deciduous Orchards	5	<1	23	<1
Fall Lettuce	12	<1	9	<1
Small Grains	36	2	67	<1
Spring Lettuce	31	2	18	<1
Sudan	62	4	219	3
Total*	**1,585**	**100%**	**6,994**	**100%**

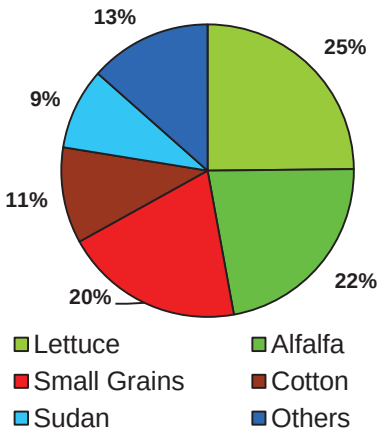
*Due to rounding, totals may differ from the sum of the individual values.

Wellton-Mohawk Irrigation and Drainage District - AZ

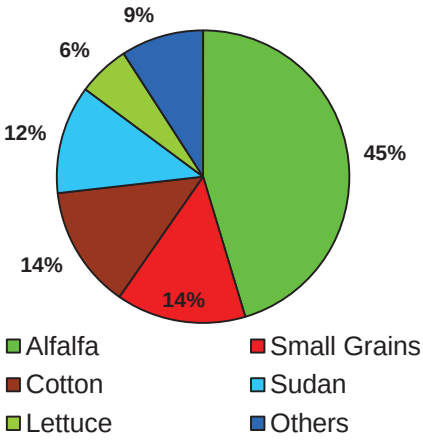
2009

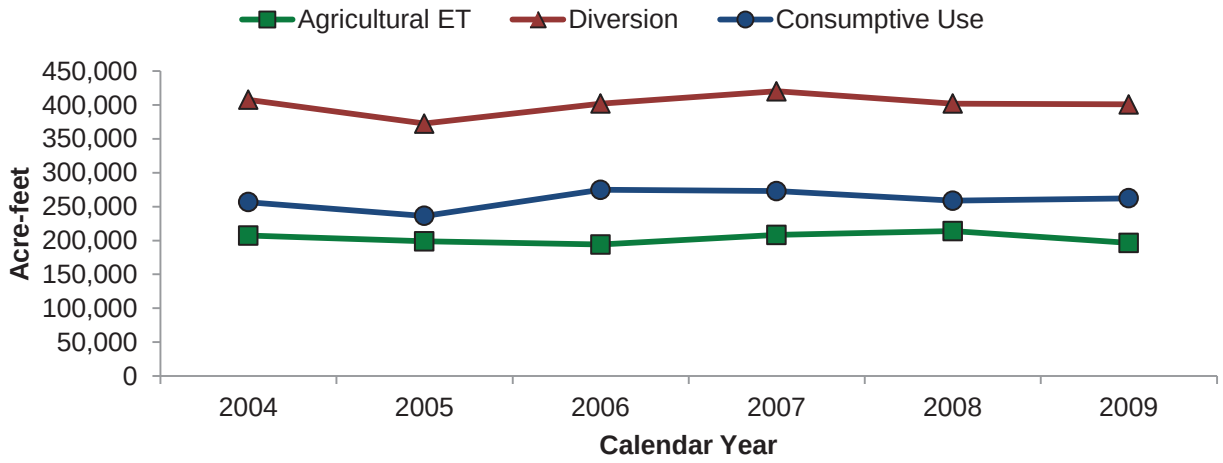
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	58,298
Gross Cropped Acres:	81,554
Net Cropped Acres:	56,120
Fallowed/Idle Acres:	2,178
Agricultural Evapotranspiration (acre-feet):	196,305
Riparian	
Riparian Vegetation Acres:	2
Riparian Evapotranspiration (acre-feet):	5
Open Water	
Open Water Acres:	135
Open Water Evaporation (acre-feet):	743

Major Crop Types



Annual Agricultural ET





Wellton-Mohawk Irrigation and Drainage District - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	18,180	22	89,016	45
Bermuda/Grass	2,382	3	7,035	4
Citrus - Mature	369	<1	1,235	<1
Citrus - Young	46	<1	93	<1
Cotton	8,654	11	26,561	14
Crucifers	5,135	6	4,279	2
Dates	7	<1	36	<1
Fall Lettuce	11,084	14	7,047	4
Fall Melons	367	<1	364	<1
Field Grain	383	<1	849	<1
Legume/Solanum Veg.	297	<1	300	<1
Oil Crops	249	<1	682	<1
Small Grains	16,171	20	28,137	14
Small Vegetables	990	1	1,710	<1
Spring Lettuce	9,163	11	4,161	2
Spring Melons	753	<1	1,311	<1
Sudan	7,317	9	23,469	12
Sugar Beets (Summer)	9	<1	22	<1
Total*	**81,554**	**100%**	**196,305**	**100%**

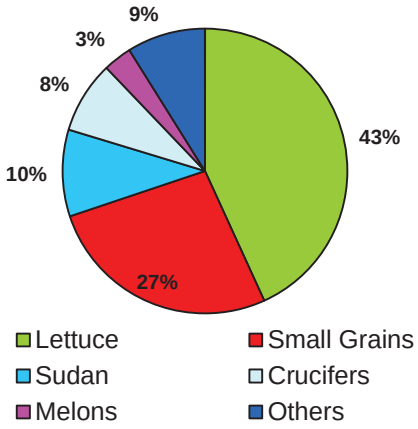
*Due to rounding, totals may differ from the sum of the individual values.

Yuma County Water Users' Association - AZ

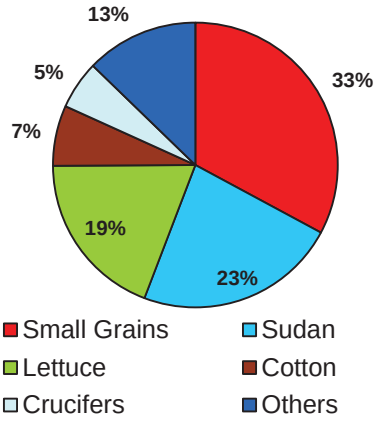
2009

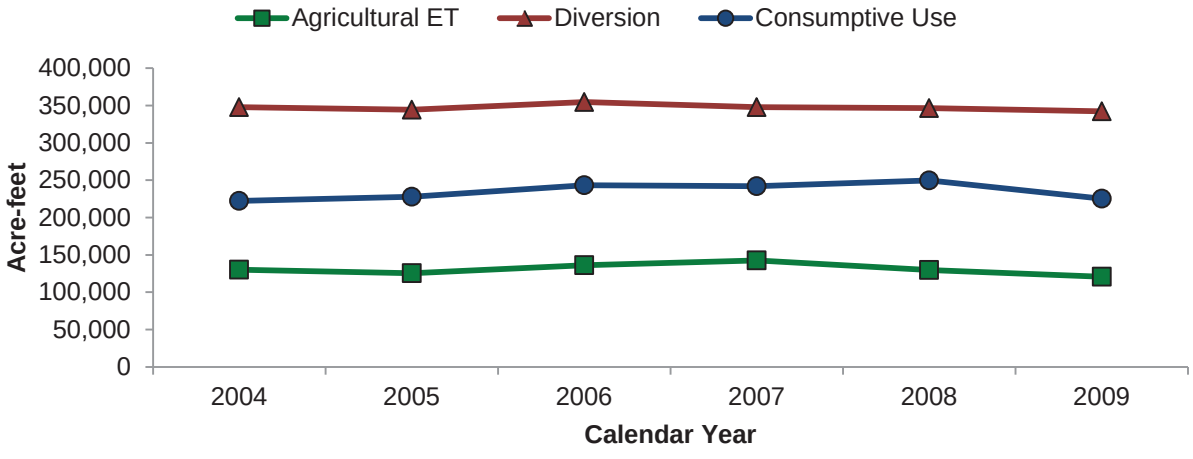
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	41,291
Gross Cropped Acres:	79,714
Net Cropped Acres:	40,960
Fallowed/Idle Acres:	331
Agricultural Evapotranspiration (acre-feet):	120,582
Riparian	
Riparian Vegetation Acres:	3
Riparian Evapotranspiration (acre-feet):	8
Open Water	
Open Water Acres:	311
Open Water Evaporation (acre-feet):	1,898

Major Crop Types



Annual Agricultural ET





Yuma County Water Users' Association - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	306	<1	1,615	1
Bermuda/Grass	296	<1	1,076	<1
Citrus - Declining	5	<1	10	<1
Citrus - Mature	319	<1	1,187	<1
Cotton	2,431	3	8,275	7
Crucifers	6,513	8	6,622	5
Dates	251	<1	1,472	1
Deciduous Orchards	88	<1	416	<1
Fall Lettuce	19,332	24	14,483	12
Fall Melons	731	<1	855	<1
Field Grain	26	<1	59	<1
Grapes	1	<1	2	<1
Legume/Solanum Veg.	1,671	2	2,090	2
Miscellaneous herbs	119	<1	141	<1
Oil Crops	52	<1	149	<1
Perennial Vegetables	13	<1	60	<1
Small Grains	21,265	27	39,636	33
Small Vegetables	1,511	2	2,928	2
Spring Lettuce	15,088	19	8,521	7
Spring Melons	1,855	2	3,308	3
Sudan	7,841	10	27,679	23
Total*	**79,714**	**100%**	**120,582**	**100%**

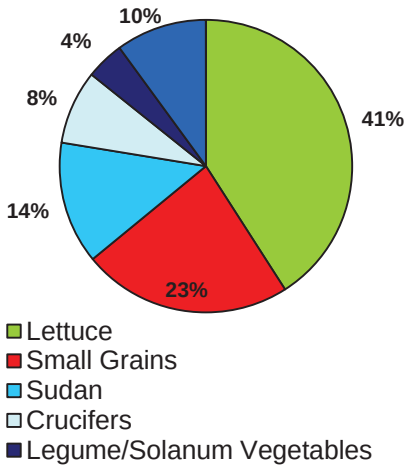
*Due to rounding, totals may differ from the sum of the individual values.

Yuma Irrigation District - AZ

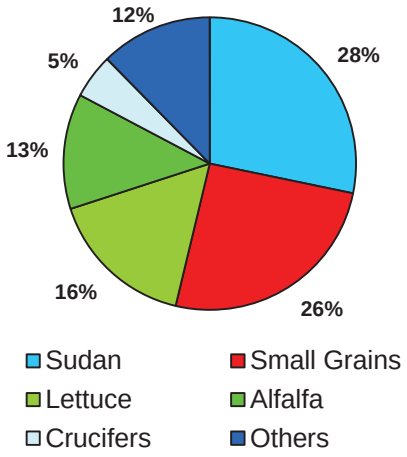
2009

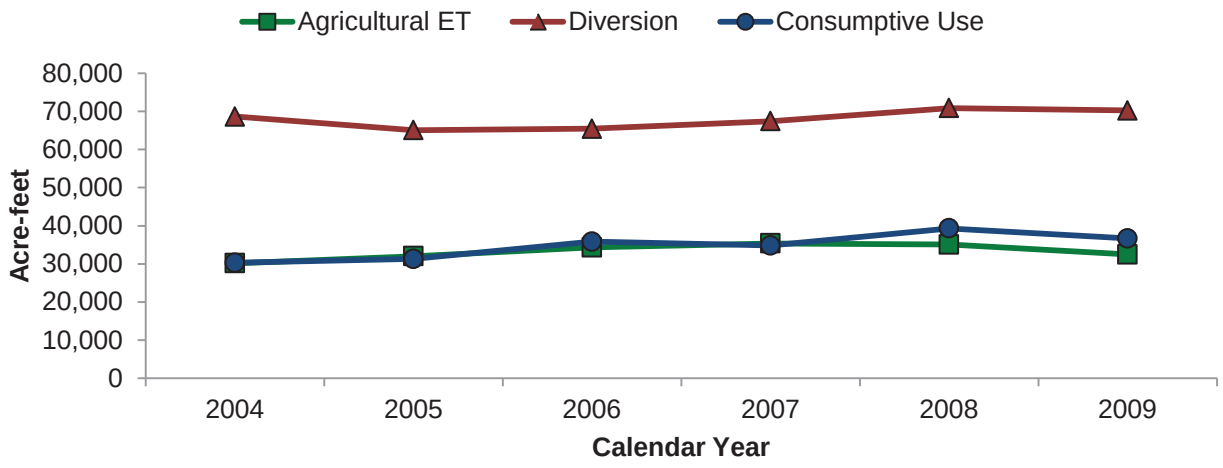
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	10,014
Gross Cropped Acres:	19,217
Net Cropped Acres:	9,921
Fallowed/Idle Acres:	92
Agricultural Evapotranspiration (acre-feet):	32,479
Riparian	
Riparian Vegetation Acres:	263
Riparian Evapotranspiration (acre-feet):	711
Open Water	
Open Water Acres:	62
Open Water Evaporation (acre-feet):	379

Major Crop Types



Annual Agricultural ET





Yuma Irrigation District - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	759	4	4,136	13
Bermuda/Grass	35	<1	110	<1
Citrus - Mature	12	<1	45	<1
Cotton	377	2	1,284	4
Crucifers	1,568	8	1,594	5
Dates	20	<1	115	<1
Fall Lettuce	4,519	24	3,386	10
Field Grain	18	<1	42	<1
Legume/Solanum Veg.	811	4	1,014	3
Oil Crops	57	<1	163	<1
Small Grains	4,445	23	8,285	26
Small Vegetables	259	1	502	2
Spring Lettuce	3,346	17	1,890	6
Spring Melons	351	2	625	2
Sudan	2,599	14	9,173	28
Sugar Beets (Summer)	41	<1	113	<1
Total*	**19,217**	**100%**	**32,479**	**100%**

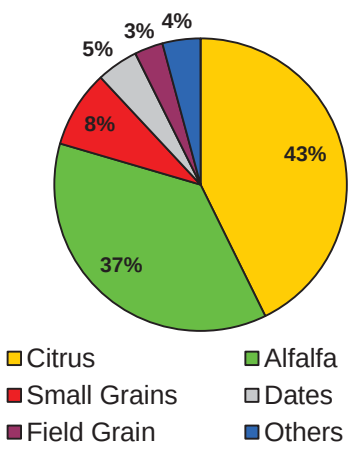
*Due to rounding, totals may differ from the sum of the individual values.

Yuma Mesa Irrigation and Drainage District - AZ

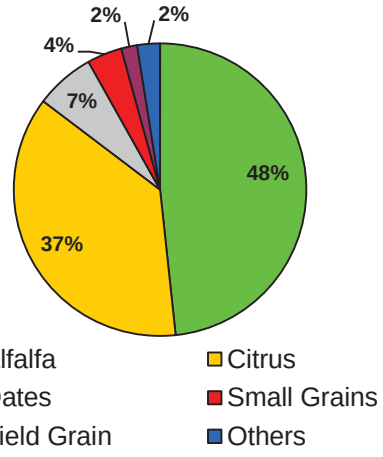
2009

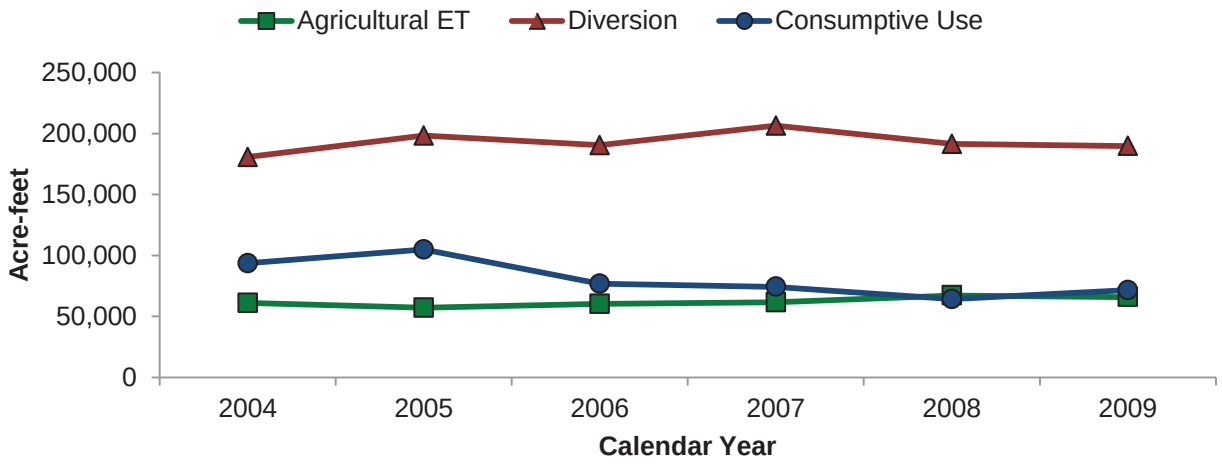
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	16,617
Gross Cropped Acres:	16,007
Net Cropped Acres:	15,951
Fallowed/Idle Acres:	666
Agricultural Evapotranspiration (acre-feet):	65,934
Riparian	
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-
Open Water	
Open Water Acres:	170
Open Water Evaporation (acre-feet):	1,040

Major Crop Types



Annual Agricultural ET





Yuma Mesa Irrigation and Drainage District - AZ

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	5,894	37	31,847	48
Bermuda/Grass	218	1	703	1
Citrus - Declining	567	4	1,475	2
Citrus - Mature	5,982	37	22,292	34
Citrus - Young	287	2	641	<1
Crucifers	84	<1	85	<1
Dates	735	5	4,324	7
Deciduous Orchards	1	<1	3	<1
Fall Lettuce	35	<1	26	<1
Field Grain	504	3	1,154	2
Legume/Solanum Veg.	35	<1	44	<1
Small Grains	1,365	9	2,545	4
Small Vegetables	63	<1	122	<1
Spring Lettuce	49	<1	27	<1
Spring Melons	9	<1	16	<1
Sudan	178	1	628	<1
Total*	**16,007**	**100%**	**65,934**	**100%**

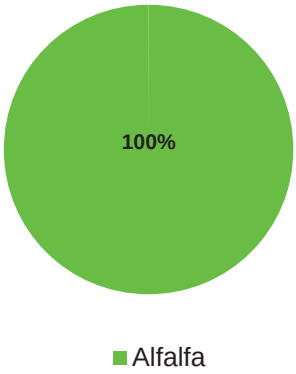
*Due to rounding, totals may differ from the sum of the individual values.

Chemehuevi Indian Reservation - CA

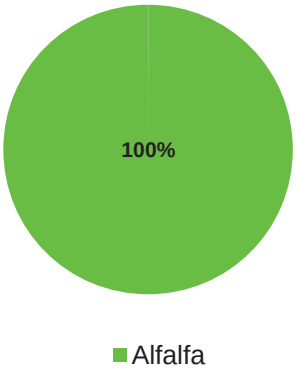
2009

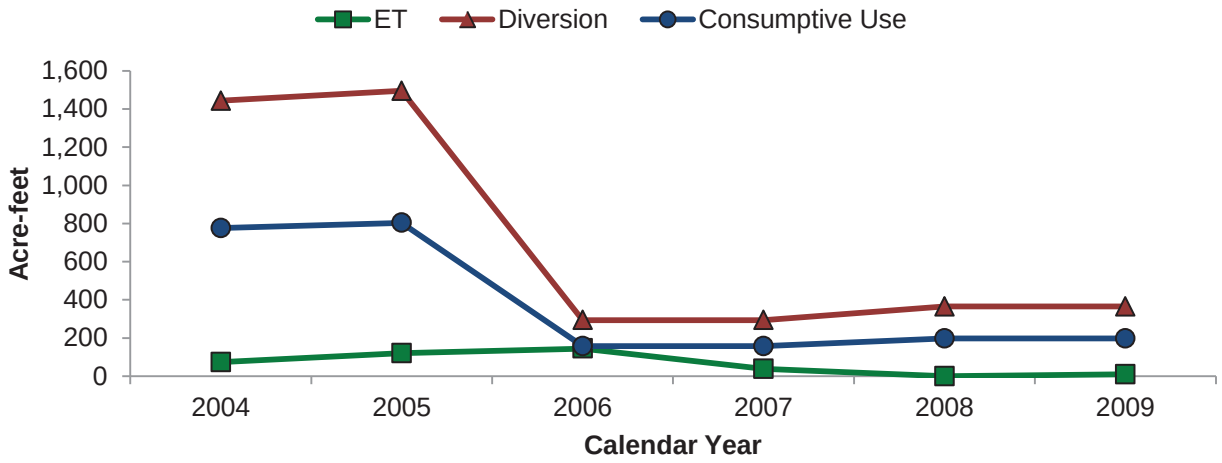
River Reach:	Davis Dam to Parker Dam
Agriculture	
Irrigable Acres:	58
Gross Cropped Acres:	4
Net Cropped Acres:	4
Fallowed/Idle Acres:	54
Agricultural Evapotranspiration (acre-feet):	10
Riparian	
Riparian Vegetation Acres:	26
Riparian Evapotranspiration (acre-feet):	50
Open Water	
Open Water Acres:	-
Open Water Evaporation (acre-feet):	-

Major Crop Types



Annual Agricultural ET





Chemehuevi Indian Reservation - CA

2009

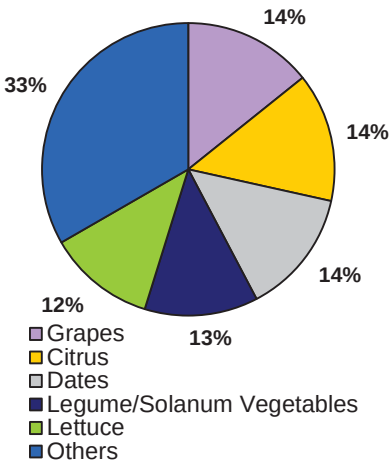
Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	4	100	10	100
Total	**4**	**100%**	**10**	**100%**

Coachella Valley Water District - CA

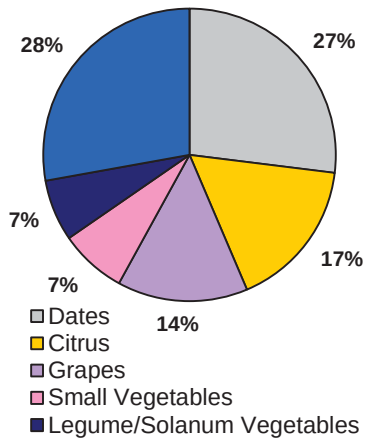
2009

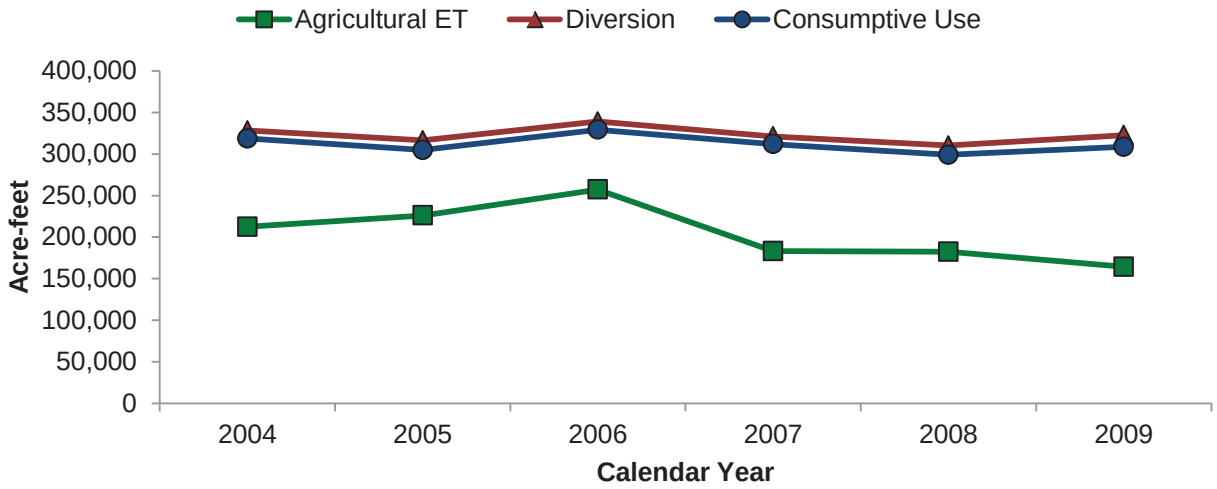
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	58,099
Gross Cropped Acres:	56,743
Net Cropped Acres:	50,124
Fallowed/Idle Acres:	7,975
Agricultural Evapotranspiration (acre-feet):	164,239
Riparian	
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-
Open Water	
Open Water Acres:	902
Open Water Evaporation (acre-feet):	5,634

Major Crop Types



Annual Agricultural ET





Coachella Valley Water District - CA

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	621	1	3,058	2
Bermuda/Grass	1,860	3	7,788	5
Citrus - Declining	49	<1	124	<1
Citrus - Mature	6,997	12	24,950	15
Citrus - Young	1,032	2	2,212	1
Crucifers	3,351	6	3,935	2
Dates	7,830	14	44,292	27
Deciduous Orchards	306	<1	1,362	<1
Fall Lettuce	2,918	5	4,420	3
Fall Melons	302	<1	481	<1
Field Grain	2,860	5	7,909	5
Grapes	8,085	14	23,689	14
Legume/Solanum Veg.	7,107	13	11,112	7
Miscellaneous herbs	760	1	1,646	1
Moist Soil Unit	82	<1	414	<1
Perennial Vegetables	1,165	2	5,238	3
Small Grains	235	<1	510	<1
Small Vegetables	5,781	10	12,131	7
Spring Lettuce	3,825	7	5,873	4
Spring Melons	1,163	2	2,064	1
Sudan	177	<1	519	<1
Tomatoes	236	<1	511	<1
Total*	**56,743**	**100%**	**164,239**	**100%**

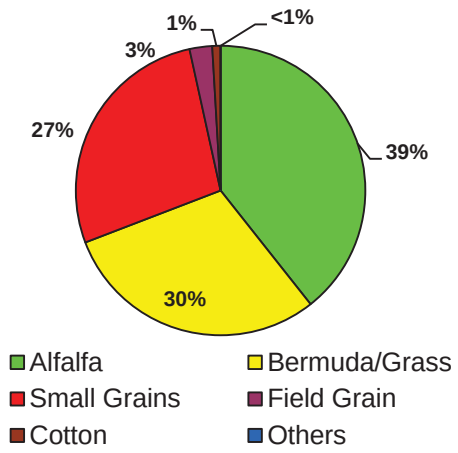
*Due to rounding, totals may differ from the sum of the individual values.

Fort Mojave Indian Reservation - CA

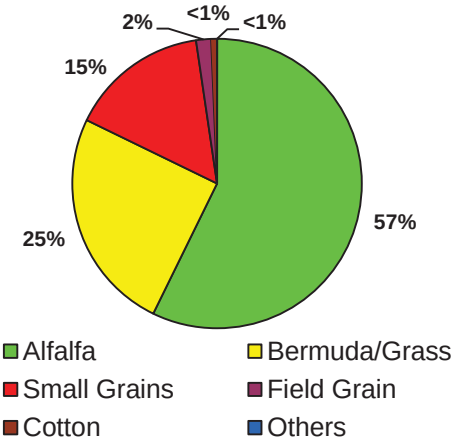
2009

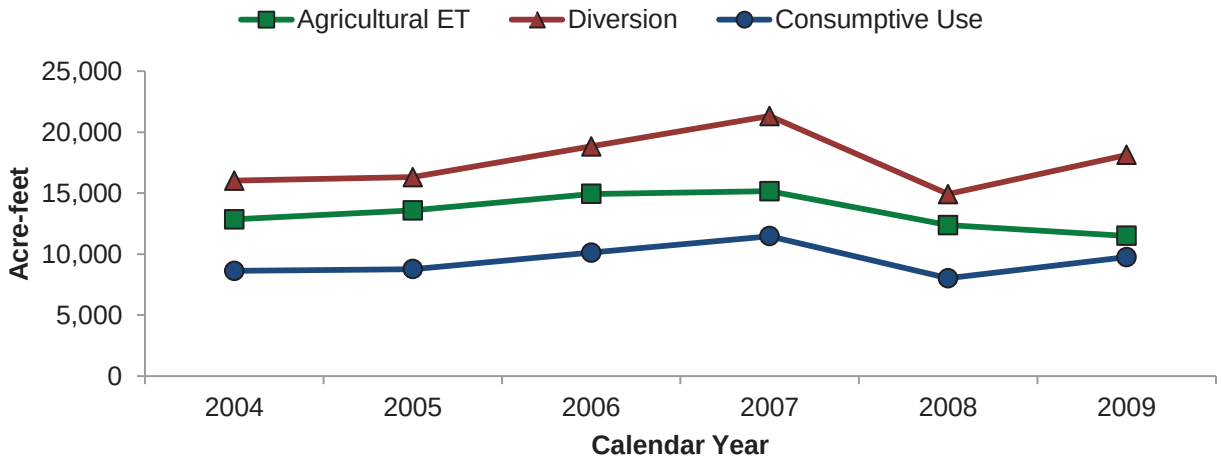
River Reach:	Davis Dam to Parker Dam
Agriculture	
Irrigable Acres:	3,218
Gross Cropped Acres:	3,107
Net Cropped Acres:	3,096
Fallowed/Idle Acres:	122
Agricultural Evapotranspiration (acre-feet):	11,499
Riparian	
Riparian Vegetation Acres:	1,024
Riparian Evapotranspiration (acre-feet):	4,817
Open Water	
Open Water Acres:	-
Open Water Evaporation (acre-feet):	-

Major Crop Types



Annual Agricultural ET





Fort Mojave Indian Reservation - CA

2009

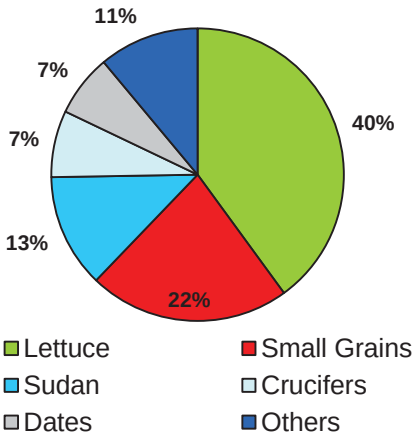
Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	1,223	39	6,585	57
Bermuda/Grass	926	30	2,868	25
Cotton	29	<1	77	<1
Field Grain	78	3	190	2
Small Grains	851	27	1,779	15
Total*	**3,107**	**100%**	**11,499**	**100%**

*Due to rounding, totals may differ from the sum of the individual values.

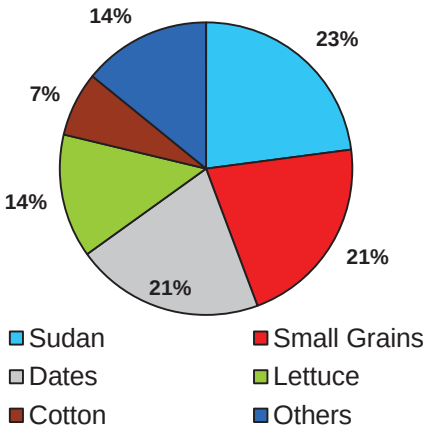
Yuma Project Reservation Division
Bard Unit - CA
2009

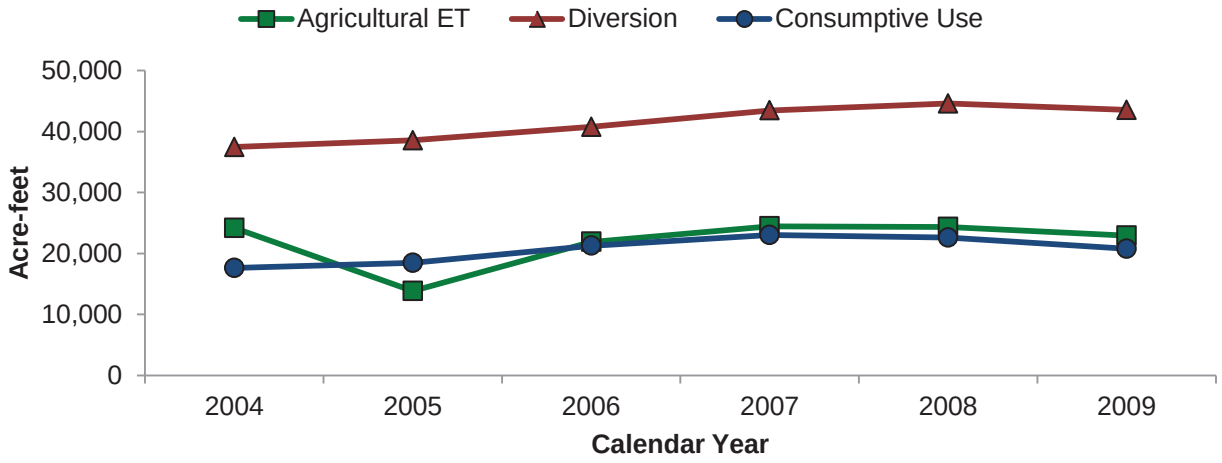
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	6,387
Gross Cropped Acres:	11,826
Net Cropped Acres:	6,315
Fallowed/Idle Acres:	72
Agricultural Evapotranspiration (acre-feet):	22,906
Riparian	
Riparian Vegetation Acres:	176
Riparian Evapotranspiration (acre-feet):	866
Open Water	
Open Water Acres:	28
Open Water Evaporation (acre-feet):	173

Major Crop Types



Annual Agricultural ET





Yuma Project Reservation Division
Bard Unit - CA
2009

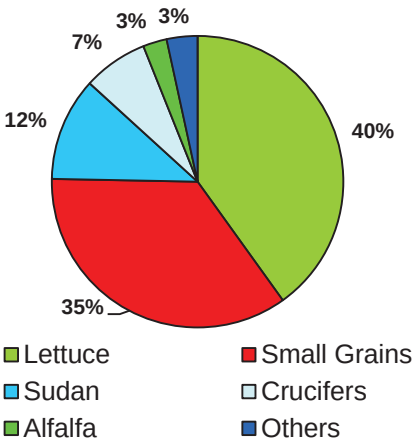
Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	148	1	831	4
Citrus - Mature	152	1	543	2
Cotton	479	4	1,630	7
Crucifers	869	7	883	4
Dates	811	7	4,765	21
Deciduous Orchards	7	<1	31	<1
Fall Lettuce	2,498	21	1,871	8
Legume/Solanum Veg.	33	<1	41	<1
Small Grains	2,626	22	4,895	21
Small Vegetables	238	2	462	2
Spring Lettuce	2,228	19	1,259	5
Spring Melons	251	2	447	2
Sudan	1,487	13	5,248	23
Total*	**11,826**	**100%**	**22,906**	**100%**

*Due to rounding, totals may differ from the sum of the individual values.

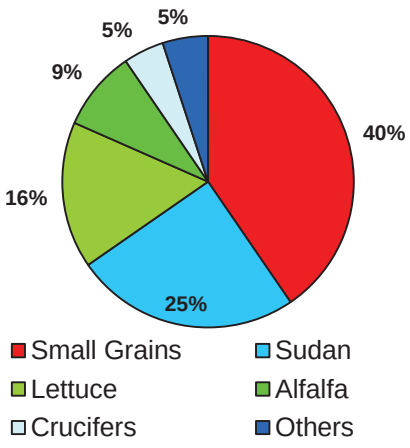
Yuma Project Reservation Division
Indian Unit - CA
2009

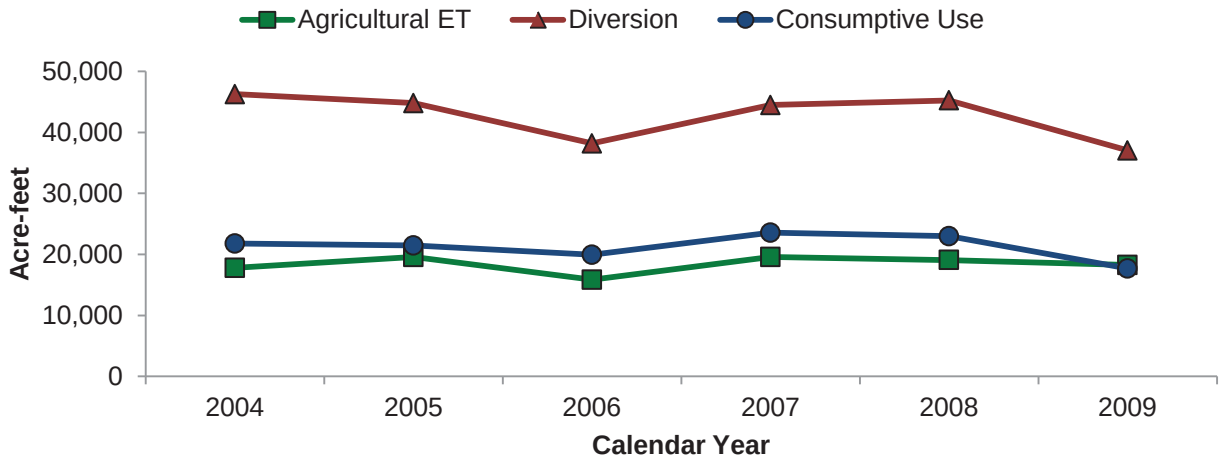
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	6,160
Gross Cropped Acres:	11,234
Net Cropped Acres:	6,005
Fallowed/Idle Acres:	155
Agricultural Evapotranspiration (acre-feet):	18,238
Riparian	
Riparian Vegetation Acres:	305
Riparian Evapotranspiration (acre-feet):	1,320
Open Water	
Open Water Acres:	19
Open Water Evaporation (acre-feet):	116

Major Crop Types



Annual Agricultural ET





Yuma Project Reservation Division
Indian Unit - CA
2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	298	3	1,616	9
Bermuda/Grass	132	1	435	2
Cotton	5	<1	18	<1
Crucifers	807	7	821	4
Dates	9	<1	55	<1
Fall Lettuce	2,289	20	1,715	9
Legume/Solanum Veg.	32	<1	40	<1
Small Grains	3,957	35	7,375	40
Small Vegetables	50	<1	98	<1
Spring Lettuce	2,215	20	1,251	7
Spring Melons	152	1	272	1
Sudan	1,287	11	4,542	25
Total*	**11,234**	**100%**	**18,238**	**100%**

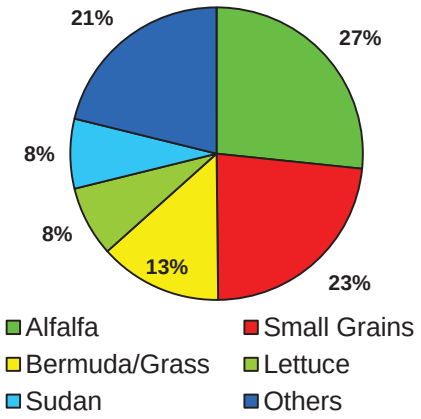
*Due to rounding, totals may differ from the sum of the individual values.

Imperial Irrigation District - CA

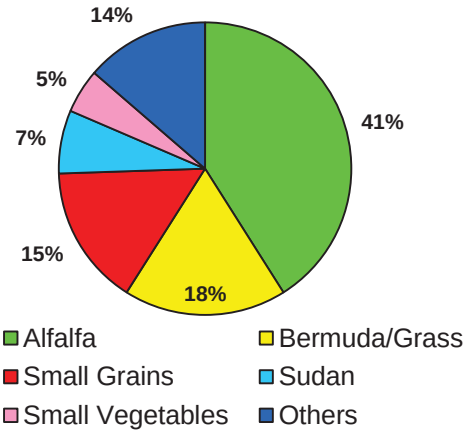
2009

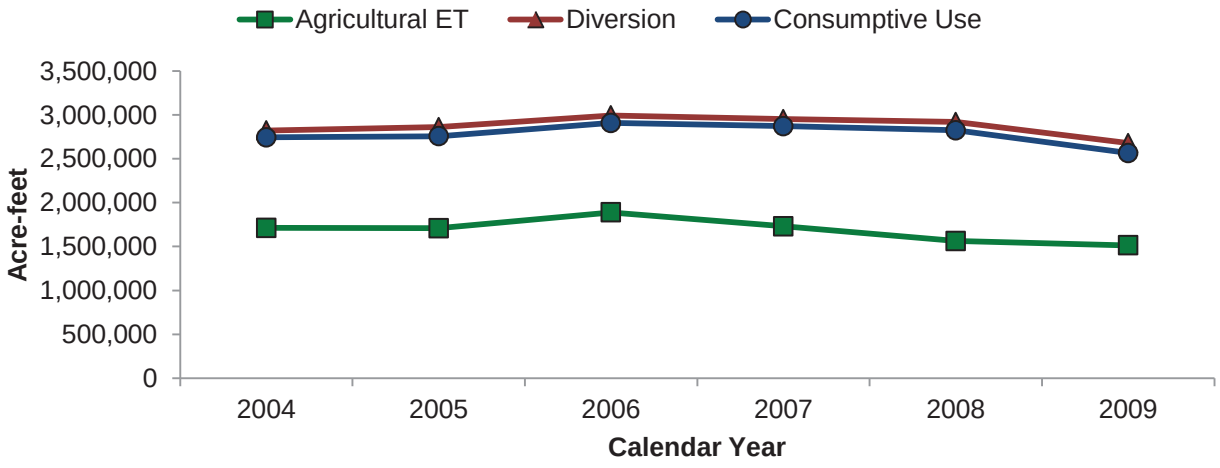
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	430,885
Gross Cropped Acres:	465,803
Net Cropped Acres:	400,235
Fallowed/Idle Acres:	30,651
Agricultural Evapotranspiration (acre-feet):	1,514,046
Riparian	
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-
Open Water	
Open Water Acres:	1,689
Open Water Evaporation (acre-feet):	10,415

Major Crop Types



Annual Agricultural ET





Imperial Irrigation District - CA

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	124,133	27	620,944	41
Bermuda/Grass	63,132	14	272,271	18
Cane/Bamboo	384	<1	2,164	<1
Citrus - Declining	138	<1	344	<1
Citrus - Mature	4,774	1	17,019	1
Citrus - Young	1,371	<1	2,951	<1
Crucifers	17,688	4	20,768	1
Dates	727	<1	4,099	<1
Deciduous Orchards	257	<1	1,105	<1
Fall Lettuce	21,761	5	32,962	2
Fall Melons	39	<1	63	<1
Field Grain	9,360	2	25,888	2
Legume/Solanum Veg.	1,174	<1	1,835	<1
Moist Soil Unit	1,234	<1	6,241	<1
Oil Crops	481	<1	1,111	<1
Perennial Vegetables	121	<1	545	<1
Root Vegetables	34	<1	23	<1
Small Grains	108,002	23	234,487	15
Small Vegetables	35,219	8	73,905	5
Spring Lettuce	14,343	3	22,020	1
Spring Melons	4,896	1	8,690	<1
Sudan	35,952	8	105,546	7
Sugar Beets (Summer)	20,497	4	58,880	4
Tomatoes	86	<1	186	<1
Total*	**465,803**	**100%**	**1,514,046**	**100%**

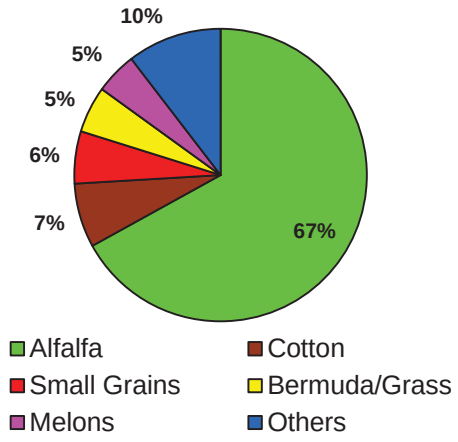
*Due to rounding, totals may differ from the sum of the individual values.

Palo Verde Irrigation District - CA

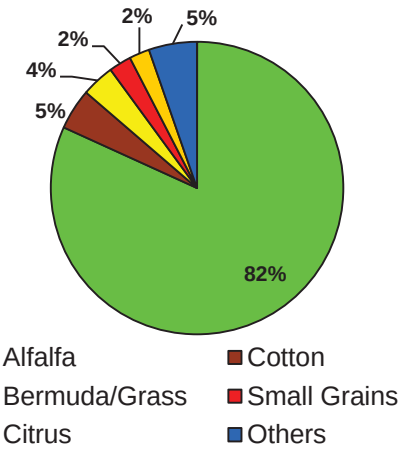
2009

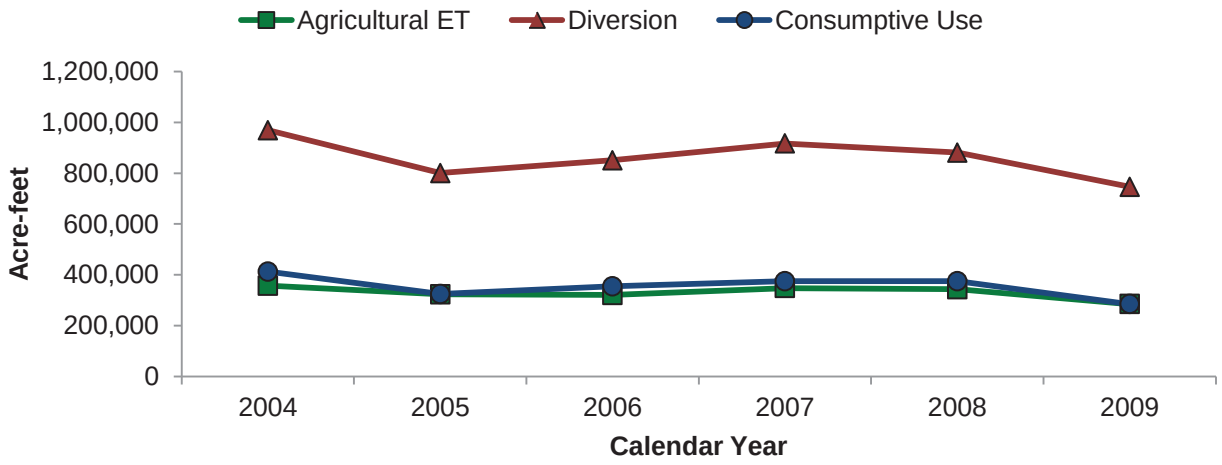
River Reach:	Parker Dam to Imperial Dam
Agriculture	
Irrigable Acres:	89,826
Gross Cropped Acres:	62,727
Net Cropped Acres:	65,492
Fallowed/Idle Acres:	24,335
Agricultural Evapotranspiration (acre-feet):	291,372
Riparian	
Riparian Vegetation Acres:	2,372
Riparian Evapotranspiration (acre-feet):	8,288
Open Water	
Open Water Acres:	142
Open Water Evaporation (acre-feet):	778

Major Crop Types



Annual Agricultural ET





Palo Verde Irrigation District - CA

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	42,011	67	238,316	82
Bermuda/Grass	3,224	5	10,585	4
Citrus - Declining	4	<1	10	<1
Citrus - Mature	1,630	3	6,030	2
Citrus - Young	236	<1	523	<1
Cotton	4,449	7	13,190	5
Crucifers	1,418	2	1,478	<1
Dates	112	<1	677	<1
Deciduous Orchards	242	<1	1,246	<1
Fall Lettuce	350	<1	179	<1
Fall Melons	326	<1	420	<1
Field Grain	1,183	2	2,952	1
Grapes	71	<1	221	<1
Small Grains	3,620	6	7,188	2
Small Vegetables	130	<1	202	<1
Spring Lettuce	455	<1	317	<1
Spring Melons	2,557	4	5,304	2
Sudan	708	1	2,535	<1
Total*	**62,727**	**100%**	**291,372**	**100%**

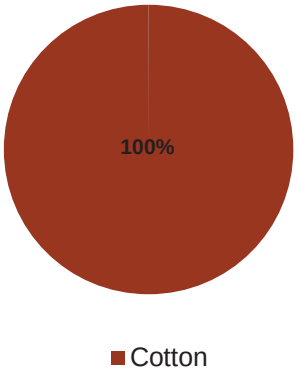
*Due to rounding, totals may differ from the sum of the individual values.

Fort Mojave Indian Reservation - NV

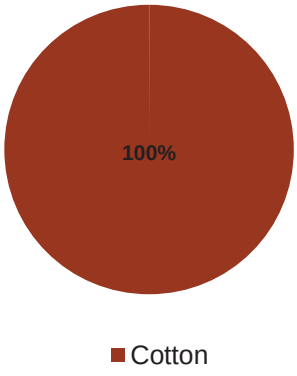
2009

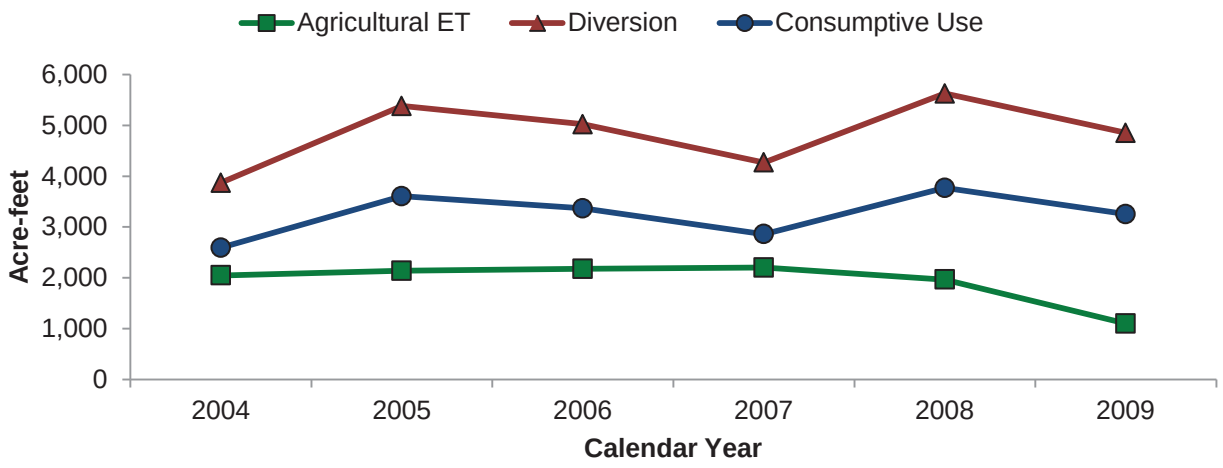
River Reach:	Davis Dam to Parker Dam
Agriculture	
Irrigable Acres:	412
Gross Cropped Acres:	412
Net Cropped Acres:	412
Fallowed/Idle Acres:	-
Agricultural Evapotranspiration (acre-feet):	1,103
Riparian	
Riparian Vegetation Acres:	2,515
Riparian Evapotranspiration (acre-feet):	5,867
Open Water	
Open Water Acres:	12
Open Water Evaporation (acre-feet):	59

Major Crop Types



Annual Agricultural ET





Fort Mojave Indian Reservation - NV

2009

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Cotton	412	100	1,103	100
Total	**412**	**100%**	**1,103**	**100%**

Other Water Users Not Reported on Individual Fact Sheets
2009 (Rev. November 2015)

		Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
Water User	River Reach	Irrigable Acres	Gross Cropped Acres	Net Cropped Acres	Fallowed/Idle Acres	Crop Type	Acres	Annual ET (acre-feet)	Acres	Annual ET (acre-feet)	Acres	Annual Evaporation (acre-feet)
Note: Due to rounding, totals may differ from the sum of the individual values.												
Arizona												
Arkelian Farm	Parker Dam to Imperial Dam	355	371	355	-	Alfalfa	159	840				
						Cotton	127	375				
						Small Grains	86	170				
						Total	**371**	**1,385**	**718**	**2,580**	**-**	**-**
State of Arizona, Alamo Dam to Bill Williams River National Wildlife Refuge*	Davis Dam to Parker Dam	410	342	342	67	Sudan	342	1,175				
						Total	**342**	**1,175**	**8,417**	**24,238**	**65**	**323**
Bill Williams River National Wildlife Refuge	Davis Dam to Parker Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**2,429**	**10,486**	**-**	**-**
Ehrenberg Farm - AZ	Parker Dam to Imperial Dam	679	645	679	-	Alfalfa	552	3,152				
						Small Grains	92	183				
						Total	**645**	**3,335**	**<1**	**1**	**-**	**-**
Fort Yuma Indian Reservation and Homesteads	Imperial Dam to Mexico	578	816	524	54	Bermuda	14	45				
						Crucifers	107	108				
						Deciduous Orchards	40	155				
						Fall Lettuce	137	102				
						Small Grains	285	532				
						Spring Lettuce	49	28				
						Sudan	186	656				
						Total	**816**	**1,626**	**1,158**	**2,798**	**7**	**44**
Fort Yuma Indian Reservation, Mittry Lake State Wildlife Area and Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-	-	-	-				
						Total	**-**	**-**	**182**	**829**	**30**	**182**
Havasu State Park (Windsor Beach)	Davis Dam to Parker Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**1,037**	**3,079**	**-**	**-**
Hillander "C" Irrigation District*	Imperial Dam to Mexico	2,590	2,424	2,060	530	Citrus - Declining	76	197				
						Citrus - Mature	1,183	4,409				
						Citrus - Young	70	155				
						Field Grain	120	276				
						Small Grains	731	1,363				
						Sudan	244	862				
						Total	**2,424**	**7,262**	-	-	-	-
Lake Mead National Recreation Area (Hoover Dam to Davis Dam)	Hoover Dam to Davis Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**242**	**486**	**3**	**17**
Lake Mead National Recreation Area (Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**109**	**327**	**63**	**313**
Mittry Lake State Wildlife Area	Imperial Dam to Mexico	37	47	37	-	Alfalfa	19	103				
						Cotton	7	24				
						Crucifers	10	10				
						Sudan	11	40				
						Total	**47**	**177**	**2,196**	**10,107**	**82**	**498**

*The origin of water used for agricultural irrigation and by riparian vegetation and open water is considered to come from sources other than the Colorado River.

Other Water Users Not Reported on Individual Fact Sheets
2009 (Rev. November 2015)

		Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
Water User	River Reach	Irrigable Acres	Gross Cropped Acres	Net Cropped Acres	Fallowed/Idle Acres	Crop Type	Acres	Annual ET (acre-feet)	Acres	Annual ET (acre-feet)	Acres	Annual Evaporation (acre-feet)
Note: Due to rounding, totals may differ from the sum of the individual values.												
Arizona (continued)												
Palo Verde Irrigation District - AZ	Parker Dam to Imperial Dam	155	147	155	-	Alfalfa	34	207				
						Cotton	101	299				
						Fall Melons	10	13				
						Spring Melons	3	6				
						Total	**147**	**525**	**121**	**566**	**46**	**252**
State of Arizona (Other users, Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**1,381**	**3,725**	**48**	**240**
State of Arizona (Other users, Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**5,809**	**21,869**	**118**	**647**
State of Arizona (Other Users, Imperial Dam to Mexico)	Imperial Dam to Mexico	3,129	3,561	2,610	518	Alfalfa	344	1,883				
						Bermuda	86	282				
						Citrus - Declining	9	24				
						Citrus - Mature	649	2,419				
						Citrus - Young	186	416				
						Cotton	119	404				
						Crucifers	96	98				
						Dates	280	1,646				
						Fall Lettuce	299	224				
						Field Grain	52	118				
						Small Grains	389	725				
						Small Vegetables	316	613				
						Spring Lettuce	366	207				
						Sudan	370	1,307				
						Total	**3,561**	**10,366**	**3,160**	**12,033**	**62**	**380**
State of Arizona - Limitrophe Section	Imperial Dam to Mexico	793	1,010	793	-	Bermuda	127	266				
						Crucifers	43	44				
						Dates	4	20				
						Fall Lettuce	92	69				
						Small Grains	459	855				
						Small Vegetables	8	16				
						Spring Lettuce	48	27				
						Spring Melons	101	180				
						Sudan	129	455				
						Total	**1,010**	**1,932**	**1,130**	**4,209**	**-**	**-**
State of Arizona - Downgradient from YMIDD	Imperial Dam to Mexico	7,422	8,505	6,664	757	Alfalfa	319	1,775				
						Bermuda	133	207				
						Citrus - Mature	729	2,716				
						Dates	1,493	8,774				
						Field Grain	721	1,652				
						Small Grains	3,061	5,705				
						Sudan	2,049	7,234				
						Total	**8,505**	**28,063**	**-**	**-**	**-**	**-**
State of Arizona - Wellton-Mohawk Area*	Imperial Dam to Mexico	2,875	1,844	2,187	688	Alfalfa	721	3,545				
						Bermuda	353	1,059				
						Cotton	9	28				
						Dates	275	1,544				
						Small Grains	486	846				
						Total	**1,844**	**7,022**	**6**	**21**	**-**	**-**

*The origin of water used for agricultural irrigation and by riparian vegetation and open water is considered to come from sources other than the Colorado River.

Other Water Users Not Reported on Individual Fact Sheets
2009 (Rev. November 2015)

		Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
Water User	River Reach	Irrigable Acres	Gross Cropped Acres	Net Cropped Acres	Fallowed/Idle Acres	Crop Type	Acres	Annual ET (acre-feet)	Acres	Annual ET (acre-feet)	Acres	Annual Evaporation (acre-feet)
Note: Due to rounding, totals may differ from the sum of the individual values.												
Arizona (continued)												
University of Arizona Agricultural Station	Imperial Dam to Mexico	85	75	75	10	Alfalfa	4	21				
						Citrus - Declining	4	10				
						Citrus - Mature	36	134				
						Citrus - Young	5	11				
						Dates	2	9				
						Deciduous Orchards	3	13				
						Legume/Solanum Veg.	1	2				
						Small Grains	8	15				
						Spring Lettuce	10	6				
						Sudan	4	14				
						Total	**75**	**234**	-	-	-	-
Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	**-**	**-**	**183**	**653**	**-**	**-**
California												
Bernal Farm	Parker Dam to Imperial Dam	-	-	-	-		-	-	259	1,246	-	-
						Total	**-**	**-**	**259**	**1,246**	-	-
Cibola National Wildlife Refuge, CA	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	**-**	**-**	**4,003**	**16,419**	**160**	**875**
Clark Farm	Parker Dam to Imperial Dam	113	-	-	113		-	-				
						Total	**-**	**-**	**34**	**133**	**-**	**-**
Colorado River Indian Reservation - CA	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	**-**	**-**	**8,591**	**34,482**	**71**	**389**
Fort Yuma Indian Reservation, CA	Imperial Dam to Mexico	1,315	1,510	1,143	172	Alfalfa	23	20				
						Cotton	73	247				
						Crucifers	36	37				
						Dates	2	9				
						Fall Lettuce	236	176				
						Fall Melons	3	4				
						Legume/Solanum Veg.	21	26				
						Small Grains	300	559				
						Spring Lettuce	407	230				
						Spring Melons	59	104				
						Sudan	340	1,202				
						Tomatoes	12	26				
						Total	**1,510**	**2,640**	**3,413**	**12,477**	**37**	**227**
Fort Yuma Indian Reservation and Picacho Recreation Area	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	**-**	**-**	**23**	**43**	**-**	**-**
Fort Yuma Indian Reservation and Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	**-**	**-**	**188**	**663**	**<1**	**1**
Havasu National Wildlife Refuge	Davis Dam to Parker Dam	-	-	-	-							
						Total	**-**	**-**	**1,371**	**5,404**	**234**	**1,159**
Imperial National Wildlife Refuge (Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	**-**	**-**	**4,830**	**21,518**	**1,049**	**5,744**
Imperial National Wildlife Refuge (Imperial Dam to Mexico)	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	**-**	**-**	**17**	**29**	-	-

*The origin of water used for agricultural irrigation and by riparian vegetation and open water is considered to come from sources other than the Colorado River.

Other Water Users Not Reported on Individual Fact Sheets
2009 (Rev. November 2015)

		Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
Water User	River Reach	Irrigable Acres	Gross Cropped Acres	Net Cropped Acres	Fallowed/Idle Acres	Crop Type	Acres	Annual ET (acre-feet)	Acres	Annual ET (acre-feet)	Acres	Annual Evaporation (acre-feet)
Note: Due to rounding, totals may differ from the sum of the individual values.												
California (continued)												
Imperial National Wildlife Refuge and Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-	-	-	-				
						Total	**-**	**-**	**11**	**47**	-	-
Moabi Regional Park	Davis Dam to Parker Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**108**	**224**	-	-
North Lyn-de Farm	Parker Dam to Imperial Dam	150	150	150	-	Alfalfa	149	830				
						Bermuda	1	2				
						Total	**150**	**833**	**-**	**-**	**-**	**-**
Picacho State Recreation Area - CA (Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**1,182**	**5,030**	**94**	**516**
Picacho State Recreation Area - CA (Imperial Dam to Mexico)	Imperial Dam to Mexico	-	-	-	-	-	-	-				
						Total	**-**	**-**	**255**	**1,104**	**2**	**11**
South Lyn-De Farm	Parker Dam to Imperial Dam	314	149	149	165	Alfalfa	149	825				
						Total	**149**	**825**	**1**	**2**	**-**	**-**
State of California (Other users, Davis Dam to Parker Dam)	Davis Dam to Parker Dam	362	141	141	222	Alfafla	18	96				
						Cotton	33	88				
						Small Grains	90	189				
						Total	**141**	**373**	**4,772**	**15,955**	**81**	**401**
State of California (Other users, Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	1,385	370	370	1,015	Citrus - Mature	76	281				
						Citrus - Young	24	53				
						Dates	215	1,274				
						Deciduous Orchards	1	5				
						Grapes	54	167				
						Total	**370**	**1,781**	**7,385**	**27,961**	**309**	**1,695**
State of California (Other users, Imperial Dam to Mexico)	Imperial Dam to Mexico	1,965	2,507	1,806	159	Alfalfa	170	849				
						Bermuda	11	36				
						Citrus - Mature	27	100				
						Crucifers	273	277				
						Dates	7	40				
						Fall Lettuce	230	173				
						Legume/Solanum Veg.	22	28				
						Small Grains	742	1,383				
						Small Vegetables	179	346				
						Spring Lettuce	495	279				
						Sudan	352	1,242				
						Total	**2,507**	**4,754**	**796**	**2,669**	**38**	**233**
Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-	-	-	-				
						Total	**-**	**-**	**1,889**	**8,193**	**4**	**22**
Lake Mead National Recreation Area - NV (Hoover Dam to Davis Dam)	Hoover Dam to Davis Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**55**	**180**	**<1**	**2**
Lake Mead National Recreation Area - NV (Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**28**	**93**	**42**	**209**
State of Nevada (Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-	-	-	-				
						Total	**-**	**-**	**3,880**	**11,685**	**55**	**274**

*The origin of water used for agricultural irrigation and by riparian vegetation and open water is considered to come from sources other than the Colorado River.

Appendix 2: Monthly Reference Values for Reference ET, Precipitation, and Crop/Riparian Vegetation ET Rates

This appendix contains area-specific data used by Reclamation to calculate the ET and evaporation estimates provided in this report. Each table displays monthly reference ET and precipitation values, monthly ET rates for crop and riparian groups, and monthly evaporation rates for open water areas.

Mohave Area ET Rate Table

2009

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	3.06	3.02	5.52	7.43	8.97	8.05	9.02	7.70	6.69	5.78	3.47	2.62	71.33
Precipitation	0.09	1.38	0.00	0.03	0.00	0.00	0.21	0.14	0.37	0.00	0.00	0.85	3.08

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.75	3	4.45	6.99	8.27	7.15	8.07	7.31	7.09	4.67	2.66	2.87	65.28
Bermuda	0	0	0	3.1	7.38	6.82	7.69	6.43	5.42	0.33	0	0	37.17
Bermuda Overseeded with Rye in Winter	3.27	2.57	4.26	3.1	7.38	6.82	7.69	6.43	5.42	2.78	3	2.31	55.03
Citrus - Declining	1.82	1.43	2.45	3.22	3.67	3.24	3.62	3.09	2.73	2.53	1.66	1.29	30.75
Citrus - Mature	2.55	2.01	3.53	4.56	5.26	4.6	5.13	4.42	3.89	3.65	2.32	1.84	43.76
Citrus - Young	1.57	1.23	2.13	2.74	3.17	2.78	3.1	2.65	2.34	2.2	1.39	1.13	26.43
Cotton	0	0	0	1.03	2.23	4.64	8.31	8.63	6.51	0.76	0	0	32.11
Crucifers	3.71	2.92	0.56	0	0	0	0	0	0	2.6	2.09	2.48	14.36
Dates	3.22	2.74	5.44	7.43	8.97	8.03	8.75	7.39	6.38	5.45	3.22	2.45	69.47
Deciduous Orchards	1.68	1.39	3.15	5.46	7.67	7.02	7.82	6.71	5.8	5.02	2.89	1.6	56.21
Field Grain	0	0	1.93	6.74	10.75	8.33	1.42	0	0	0	0	0	29.17
Grapes	0	0.22	1.63	4.81	7.62	6.82	7.3	4.91	1.68	0	0	0	34.99
Legume/Solanum Vegetables	3.92	3.09	1.95	0	0	0	0	0	0	2.09	2.55	2.65	16.25
Lettuce (Fall)	0	0	0	0	0	0	0	0	0	3.54	2.96	0	6.50
Lettuce (Spring)	3.4	3.02	2.09	0	0	0	0	0	0	0	0	0.84	9.35
Melons (Fall)	0	0	0	0	0	0	0	1.21	4.05	5.67	3.47	1.23	15.63
Melons (Spring)	0	0.37	3.7	7.27	8.91	4.29	0	0	0	0	0	0	24.54
Miscellaneous herbs	3.38	2.74	1.06	0	0	0	0	0	0	1.5	2.04	2.33	13.05
Moist Soil Unit	3.71	3.02	5.42	7.3	5.19	2.76	9.7	8.72	4.4	5.78	3.47	2.62	62.09
Oil Crops	0	1.17	4.22	8.76	11.07	8.81	1.8	0	0	0	0	0	35.83
Perennial Vegetables	1.62	1.28	2.58	5.46	8.34	7.49	8.42	7.12	5.47	3.67	1.5	1.18	54.13
Root Vegetables	0	0	0	0	0	0	0	0	2.36	4.43	3.62	2.43	12.84
Small Grains	3.19	3.42	6.25	8.14	3.01	0	0	0	0	0	0.4	1.04	25.45
Small Vegetables	3.71	3.02	4.63	0	0	0	0	0	1.22	2.35	2.68	2.62	20.23
Sudan	0	0	2.87	7.59	10.22	9.15	9.94	1.42	0	0	0	0	41.19
Sugar Beets	3.95	3.26	5.91	7.7	6.66	0.17	0	0	0.83	2.1	2.29	2.58	35.45
Tomatoes	0	1.83	4.76	8.74	10.1	3.28	0	0	0	0	0	0	28.71

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	3.26	2.58	4.79	7.08	8.34	6.82	7.29	5.85	4.9	4.5	3.06	2.13	60.60

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	1.23	1.02	2.37	4.96	8.19	8.05	9.02	7.7	6.69	4.78	1.59	0.54	56.14
barren	1.23	1.02	1.39	1.05	1.24	1.1	1.21	1.04	0.91	0.87	0.78	0.78	12.62
cw	1.23	1.02	2.66	5.6	8.85	8.14	9.19	7.72	6.71	5.14	1.85	0.6	58.71
low veg	1.32	1.05	2.54	4.98	7.53	6.87	7.71	6.62	5.72	4.46	1.8	0.67	51.27
marsh	0.99	0.79	4.39	8.84	10.64	9.59	10.73	9.17	7.89	3.24	0.86	0.7	67.83
ms_aw	1.23	1.02	2.66	5.62	8.57	7.76	8.71	7.4	6.41	4.98	1.78	0.6	56.74
ms_high	1.23	1.02	2.72	5.79	8.99	8.14	9.19	7.72	6.71	5.23	1.95	0.64	59.33
ms_low	1.23	1.02	2.37	4.52	6.95	6.49	7.29	6.21	5.4	4.28	1.52	0.54	47.82
sc/ms	1.23	1.02	2.53	5.87	9.89	9.36	10.53	9	7.78	5.19	1.58	0.5	64.48
sc_aw	1.23	1.02	2.51	5.74	9.57	9.05	10.19	8.67	7.52	5.01	1.55	0.5	62.56
sc_high	1.23	1.02	2.48	5.58	9.32	8.84	9.9	8.45	7.32	4.89	1.53	0.5	61.06
sc_low	1.23	1.02	2.08	4.58	7.93	7.76	8.73	7.41	6.45	4.37	1.4	0.5	53.46
sc_ms_aw	1.23	1.02	2.77	6.04	9.86	9.31	10.45	8.93	7.74	5.84	1.9	0.55	65.64

Parker Area ET Rate Table

2009

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	3.06	2.99	5.67	6.97	9.01	8.95	9.87	9.08	7.44	5.42	3.17	2.31	73.94
Precipitation	0.03	0.54	0.00	0.01	0.01	0.01	0.06	0.04	0.02	0.01	0.00	0.43	1.15

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.17	3	4.52	6.49	8.25	7.85	8.88	8.6	7.84	4.31	2.43	2.56	66.90
Bermuda	0	0	0	2.94	7.35	7.64	8.4	7.6	6.04	0.31	0	0	40.28
Bermuda Overseeded with Rye in Winter	2.53	2.55	4.37	2.94	7.35	7.64	8.4	7.6	6.04	2.59	2.79	2.01	56.81
Citrus - Declining	1.35	1.38	2.53	3.01	3.71	3.59	3.96	3.59	3.03	2.35	1.51	1.14	31.15
Citrus - Mature	2.01	1.98	3.62	4.29	5.29	5.11	5.63	5.2	4.33	3.43	2.11	1.65	44.65
Citrus - Young	1.22	1.19	2.16	2.58	3.15	3.09	3.4	3.11	2.62	2.04	1.25	1.01	26.82
Cotton	0	0	0	0.98	2.26	5.09	9.07	10.17	7.31	0.7	0	0	35.58
Crucifers	2.86	2.9	0.59	0	0	0	0	0	0	2.44	1.87	2.15	12.81
Dates	2.53	2.7	5.6	6.97	9.01	8.94	9.6	8.77	7.14	5.1	2.87	2.11	71.34
Deciduous Orchards	1.35	1.37	3.21	5.14	7.74	7.73	8.55	7.89	6.47	4.7	2.69	1.4	58.24
Field Grain	0	0	1.95	6.29	10.8	9.39	1.5	0	0	0	0	0	29.93
Grapes	0	0.2	1.68	4.5	7.58	7.62	7.99	5.79	1.96	0	0	0	37.32
Legume/Solanum Vegetables	3.03	3.07	1.94	0	0	0	0	0	0	1.91	2.25	2.28	14.48
Lettuce (Fall)	0	0	0	0	0	0	0	0	0	3.32	2.83	0	6.15
Lettuce (Spring)	2.64	2.99	2.11	0	0	0	0	0	0	0	0	0.78	8.52
Melons (Fall)	0	0	0	0	0	0	0	1.47	4.48	5.31	3.17	1.16	15.59
Melons (Spring)	0	0.37	3.73	6.82	8.93	5.04	0	0	0	0	0	0	24.89
Miscellaneous herbs	2.55	2.71	1.13	0	0	0	0	0	0	1.35	1.85	2.01	11.60
Moist Soil Unit	2.86	2.99	5.56	6.84	5.24	2.89	10.71	10.24	4.95	5.42	3.17	2.31	63.18
Oil Crop	0	1.19	4.31	8.22	11.14	9.94	1.95	0	0	0	0	0	36.75
Perennial Vegetables	1.25	1.3	2.63	5.13	8.4	8.36	9.26	8.45	6.1	3.43	1.39	1	56.70
Root Vegetables	0	0	0	0	0	0	0	0	2.66	4.13	3.31	2.16	12.26
Small Grains	2.46	3.34	6.38	7.61	3.06	0	0	0	0	0	0.33	0.88	24.06
Small Vegetables	2.86	2.99	4.8	0	0	0	0	0	1.32	2.16	2.44	2.31	18.88
Sudan	0	0	2.89	7.09	10.23	10.19	10.89	1.69	0	0	0	0	42.98
Sugar Beets	3.12	3.26	6.04	7.19	6.67	0.19	0	0	0.87	1.95	2.05	2.3	33.64
Tomatoes	0	1.86	4.87	8.17	10.1	3.84	0	0	0	0	0	0	28.84

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	1.93	2.14	4.7	6.48	8.16	8.34	9.07	8.4	6.87	5.27	3.17	1.76	66.29

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	0.93	1	2.42	4.61	8.21	8.95	9.87	9.08	7.44	4.49	1.53	0.47	59.00
barren	0.93	1	1.4	0.99	1.2	1.24	1.33	1.23	0.99	0.79	0.67	0.66	12.43
cw	0.93	1	2.7	5.24	8.89	9.12	10.12	9.25	7.46	4.84	1.73	0.53	61.81
low veg	1.03	1.06	2.62	4.62	7.54	7.68	8.45	7.8	6.39	4.23	1.66	0.62	53.70
marsh	0.8	0.79	4.49	8.31	10.7	10.62	11.73	10.8	8.77	3.09	0.75	0.62	71.47
ms_aw	0.93	1	2.7	5.25	8.6	8.66	9.57	8.78	7.15	4.69	1.68	0.53	59.54
ms_high	0.93	1	2.78	5.45	9.04	9.12	10.12	9.25	7.46	4.92	1.84	0.6	62.51
ms_low	0.93	1	2.43	4.22	6.97	7.25	7.99	7.35	5.99	4.02	1.42	0.47	50.04
sc/ms	0.93	1	2.6	5.51	9.88	10.46	11.54	10.61	8.68	4.9	1.52	0.46	68.09
sc_aw	0.93	1	2.59	5.35	9.55	10.1	11.16	10.25	8.38	4.72	1.48	0.46	65.97
sc_high	0.93	1	2.54	5.22	9.32	9.83	10.8	10	8.11	4.6	1.42	0.46	64.23
sc_low	0.93	1	2.1	4.29	7.96	8.67	9.58	8.78	7.15	4.11	1.31	0.45	56.33
sc_ms_aw	0.93	1	2.82	5.63	9.86	10.36	11.45	10.51	8.63	5.49	1.8	0.51	68.99

Wellton-Mohawk Area ET Rate Table

2009

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	3.06	2.91	5.21	6.53	8.18	7.84	8.72	8.29	6.83	4.72	2.47	2.10	66.86
Precipitation	0.03	0.51	0.00	0.06	0.00	0.00	0.17	0.13	0.24	0.00	0.00	0.10	1.22

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.03	2.88	4.41	5.24	6.88	7.05	7.83	7.49	5.65	5.01	2.04	2.3	58.81
Bermuda	0	0	0	2.71	6.64	6.64	7.39	6.92	5.56	0.26	0	0	36.12
Bermuda Overseeded with Rye in Winter	2.4	2.51	4.04	2.71	6.64	6.64	7.39	6.92	5.56	2.22	2.13	1.79	50.95
Citrus - Declining	1.3	1.36	2.32	2.83	3.36	3.13	3.48	3.33	2.79	2.05	1.18	1.03	28.16
Citrus - Mature	1.88	1.95	3.33	4	4.83	4.47	4.96	4.76	3.98	2.97	1.62	1.49	40.24
Citrus - Young	1.14	1.15	2.01	2.41	2.89	2.71	3	2.85	2.4	1.76	0.98	0.91	24.21
Cotton	0	0	0.84	1.71	3.19	5.3	8.42	9.29	6.61	1.47	0	0	36.83
Crucifers	0.92	0	0	0	0	0	0	0	2.38	2.38	2.26	2.1	10.04
Dates	2.22	2.56	5.04	6.53	8.03	7.56	8.41	7.98	6.53	4.43	2.45	2.08	63.82
Deciduous Orchards	1.02	1.12	2.7	4.56	6.89	6.64	7.47	7.02	5.82	4.02	2.09	1.27	50.62
Field Grain	0	0.52	3.05	7.28	9.74	6	0	0	0	0	0	0	26.59
Grapes	0	0.2	1.55	4.18	6.91	6.64	7.06	5.3	1.74	0	0	0	33.58
Legume/Solanum Vegetables	2.75	2.95	1.76	0	0	0	0	0	0	1.3	1.52	2.03	12.31
Lettuce (Fall)	0	0	0	0	0	0	0	0	1.84	3.5	2.29	0	7.63
Lettuce (Spring)	2.61	1.53	0	0	0	0	0	0	0	0	0	1.51	5.65
Melons (Fall)	0	0	0	0	0	0	0	0	3.4	4.17	2.47	1.89	11.93
Melons (Spring)	0	2.11	4.66	6.53	7.72	0	0	0	0	0	0	0	21.02
Miscellaneous herbs	2.41	2.64	1.6	0	0	0	0	0	0	1.49	1.68	1.84	11.66
Moist Soil Unit	2.71	2.91	5.1	6.44	4.83	2.65	9.34	9.38	4.58	4.72	2.47	2.1	57.23
Oil Crop	0	1.05	3.93	7.58	10.05	8.58	1.73	0	0	0	0	0	32.92
Perennial Vegetables	1.08	1.15	2.28	4.63	7.56	7.24	8.07	7.64	5.57	3.05	1.14	0.81	50.22
Root Vegetables	0	0	0	0	0	0	0	0	2.53	3.58	2.49	1.95	10.55
Small Grains	2.51	3.25	5.82	6.29	2.51	0	0	0	0	0	0	0.71	21.09
Small Vegetables	2.71	2.91	5.14	5.42	0	0	0	0	0	1.43	1.5	1.81	20.92
Sudan	0	0	0	2.72	7.95	8.85	9.91	9.06	0	0	0	0	38.49
Sugar Beets	2.89	3.14	5.53	6.66	6.03	0.15	0	0	0.88	1.72	1.58	2.04	30.62
Tomatoes	0	1.8	4.5	7.67	9.18	3.3	0	0	0	0	0	0	26.45

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	2.36	2.85	5.39	6.83	8.48	8.13	9.03	8.6	6.88	4.72	2.16	1.52	66.95

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	0.89	0.96	2.21	4.34	7.45	7.84	8.72	8.29	6.83	3.93	1.18	0.4	53.04
barren	0.89	0.96	1.3	0.96	1.16	1.1	1.2	1.14	0.93	0.71	0.56	0.62	11.53
cw	0.89	0.96	2.45	4.88	8	7.87	8.86	8.34	6.84	4.26	1.36	0.45	55.16
low veg	0.98	1.08	2.44	4.3	6.81	6.69	7.49	7.12	5.87	3.68	1.3	0.57	48.33
marsh	0.73	0.78	4.16	7.76	9.74	9.34	10.37	9.89	8.05	2.75	0.62	0.58	64.77
ms_aw	0.89	0.96	2.46	4.89	7.81	7.55	8.41	7.98	6.54	4.07	1.3	0.44	53.30
ms_high	0.89	0.96	2.53	5.08	8.13	7.87	8.86	8.34	6.84	4.3	1.45	0.53	55.78
ms_low	0.89	0.96	2.24	3.92	6.32	6.33	7.06	6.67	5.53	3.55	1.13	0.4	45.00
sc/ms	0.89	0.96	2.42	5.16	8.95	9.15	10.22	9.68	8	4.26	1.19	0.38	61.26
sc_aw	0.89	0.96	2.4	4.95	8.66	8.8	9.89	9.33	7.7	4.15	1.15	0.38	59.26
sc_high	0.89	0.96	2.37	4.88	8.47	8.63	9.59	9.11	7.45	4.02	1.13	0.38	57.88
sc_low	0.89	0.96	1.97	4.01	7.22	7.55	8.41	7.98	6.56	3.59	1.05	0.38	50.57
sc_ms_aw	0.89	0.96	2.6	5.24	8.94	9.05	10.07	9.6	7.88	4.82	1.43	0.42	61.90

Yuma Area ET Rate Table

2009

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	3.06	3.36	5.30	6.51	8.32	8.68	10.17	9.26	7.39	5.38	3.33	2.58	73.34
Precipitation	0.05	0.51	0.00	0.01	0.00	0.00	0.01	0.01	0.70	0.00	0.00	0.03	1.31

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.59	3.36	4.56	5.14	6.97	7.66	9.05	8.34	6.23	5.73	2.62	2.77	65.02
Bermuda	0	0	0	2.71	6.79	7.34	8.59	7.71	6	0.31	0	0	39.45
Bermuda Overseeded with Rye in Winter	3.11	2.87	4.11	2.71	6.79	7.34	8.59	7.71	6	2.55	2.92	2.27	56.97
Citrus - Declining	1.68	1.57	2.36	2.78	3.44	3.47	4.04	3.71	3.01	2.35	1.59	1.29	31.29
Citrus - Mature	2.47	2.25	3.39	4	4.9	4.95	5.84	5.29	4.31	3.36	2.22	1.85	44.83
Citrus - Young	1.45	1.35	2.04	2.4	2.91	2.99	3.5	3.2	2.59	2.04	1.32	1.07	26.86
Cotton	0	0	0.83	1.7	3.23	5.92	9.89	10.4	7.23	1.64	0	0	40.84
Crucifers	1.25	0	0	0	0	0	0	0	2.6	2.74	3.04	2.58	12.21
Dates	2.88	2.89	5.12	6.51	8.19	8.39	9.86	8.95	7.09	5.07	3.15	2.51	70.61
Deciduous Orchards	1.34	1.29	2.72	4.57	7.03	7.42	8.66	7.89	6.31	4.57	2.73	1.59	56.12
Field Grain	0	0.63	3.09	7.28	9.88	6.6	0	0	0	0	0	0	27.48
Grapes	0	0.24	1.55	4.19	7.03	7.36	8.26	5.89	1.99	0	0	0	36.51
Legume/Solanum Vegetables	3.69	3.45	1.88	0	0	0	0	0	0	1.5	2.1	2.51	15.13
Lettuce (Fall)	0	0	0	0	0	0	0	0	1.89	4.01	3.09	0	8.99
Lettuce (Spring)	3.37	1.71	0	0	0	0	0	0	0	0	0	1.82	6.90
Melons (Fall)	0	0	0	0	0	0	0	0	3.67	4.75	3.33	2.3	14.05
Melons (Spring)	0	2.46	4.7	6.51	7.81	0	0	0	0	0	0	0	21.48
Miscellaneous herbs	3.18	3.07	1.71	0	0	0	0	0	0	1.77	2.3	2.28	14.31
Moist Soil Unit	3.5	3.36	5.2	6.41	4.82	2.91	11	10.45	5.05	5.38	3.33	2.58	63.99
Oil Crop	0	1.23	3.94	7.59	10.22	9.5	1.88	0	0	0	0	0	34.36
Perennial Vegetables	1.41	1.36	2.32	4.64	7.68	8.04	9.37	8.54	6.02	3.47	1.52	1.04	55.41
Root Vegetables	0	0	0	0	0	0	0	0	2.74	4.11	3.5	2.41	12.76
Small Grains	3.21	3.76	5.93	6.24	2.46	0	0	0	0	0	0	0.89	22.49
Small Vegetables	3.5	3.36	5.23	5.41	0	0	0	0	0	1.63	2.02	2.22	23.37
Sudan	0	0	0	2.72	8.2	9.83	11.5	10.11	0	0	0	0	42.36
Sugar Beets	3.73	3.6	5.61	6.63	6.1	0.17	0	0	0.87	1.99	2.13	2.53	33.36
Tomatoes	0	2.07	4.54	7.62	9.31	3.5	0	0	0	0	0	0	27.04

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	2.99	3.23	5.47	6.81	8.63	8.98	10.51	9.58	7.5	5.38	2.91	1.95	73.94

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	1.17	1.12	2.28	4.33	7.61	8.68	10.17	9.26	7.39	4.45	1.61	0.55	58.62
barren	1.17	1.12	1.33	0.92	1.18	1.2	1.36	1.24	1.01	0.79	0.72	0.76	12.80
cw	1.17	1.12	2.55	4.89	8.16	8.82	10.45	9.42	7.43	4.83	1.81	0.6	61.25
low veg	1.26	1.18	2.44	4.3	6.94	7.45	8.74	7.93	6.34	4.2	1.75	0.67	53.20
marsh	0.92	0.88	4.19	7.73	9.88	10.32	12.1	10.97	8.72	3.09	0.82	0.63	70.25
ms_aw	1.17	1.12	2.55	4.9	7.93	8.38	9.86	8.95	7.09	4.65	1.77	0.59	58.96
ms_high	1.17	1.12	2.57	5.06	8.28	8.82	10.45	9.42	7.43	4.87	1.91	0.64	61.74
ms_low	1.17	1.12	2.25	3.96	6.43	7.01	8.24	7.51	5.98	4.01	1.48	0.55	49.71
sc/ms	1.17	1.12	2.45	5.13	9.19	10.15	11.89	10.85	8.63	4.84	1.57	0.52	67.51
sc_aw	1.17	1.12	2.43	5	8.86	9.79	11.5	10.45	8.32	4.74	1.54	0.52	65.44
sc_high	1.17	1.12	2.36	4.86	8.64	9.54	11.12	10.17	8.08	4.56	1.49	0.52	63.63
sc_low	1.17	1.12	1.99	4	7.35	8.38	9.86	8.95	7.09	4.09	1.36	0.52	55.88
sc_ms_aw	1.17	1.12	2.65	5.25	9.12	10.06	11.78	10.7	8.54	5.48	1.88	0.57	68.32

IID and Coachella Area ET Rate Table

2009

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	3.06	3.17	5.98	7.13	8.56	8.07	9.20	8.37	6.91	5.08	3.06	2.10	70.69
Precipitation	0.03	0.25	0.05	0.06	0.06	0.00	0.00	0.02	0.01	0.00	0.01	0.30	0.78

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.43	3.68	4.75	5.61	6.97	6.42	7.49	7	5.65	5.87	2.48	2.39	60.74
Bermuda	0	0.1	5.2	6.83	8.25	7.77	8.89	8.05	6.07	0.63	0	0	51.79
Bermuda Overseeded with Rye in Winter	2.74	3.09	5.67	6.83	8.25	7.77	8.89	8.05	6.07	0.63	0	0.11	58.10
Cane/Bamboo	0.83	0.81	4.67	8.49	10.12	9.6	10.93	9.95	8.15	2.97	0.71	0.55	67.78
Citrus - Declining	1.46	1.49	2.69	3.09	3.51	3.2	3.66	3.35	2.84	2.21	1.45	1.02	29.97
Citrus - Mature	2.16	2.1	3.83	4.4	5.03	4.61	5.27	4.77	4.01	3.19	2.06	1.49	42.92
Citrus - Young	1.28	1.26	2.31	2.64	3.03	2.79	3.16	2.88	2.43	1.9	1.23	0.91	25.82
Cotton	0	0.07	1.77	1.97	4.14	6.65	10.39	8.33	3.77	0.53	0	0	37.62
Crucifers	3.1	1.2	0.18	0	0	0	0	0	2.63	1.82	2.82	2.49	14.24
Dates	2.53	2.73	5.78	7.13	8.38	7.77	8.9	8.07	6.61	4.78	2.92	2.08	67.68
Deciduous Orchards	1.2	1.25	3.09	4.99	7.23	6.9	7.84	7.13	5.88	4.33	2.51	1.29	53.64
Field Grain	0	0.81	2.84	7.08	10.18	8.43	3.56	0.32	0	0	0	0	33.22
Grapes	0	0.2	1.73	4.6	7.27	6.86	7.45	5.32	1.74	0	0	0	35.17
Legume/Solanum	3.37	3.09	5.67	2.03	0	0	0	0	0	1.18	1.49	2.11	18.94
Lettuce (Fall)	0.61	0	0	0	0	0	0	0.45	6.34	5.41	3.35	2.11	18.27
Lettuce (Spring)	3.31	3.43	5.97	0.84	0	0	0	0	0	0.26	2.58	2.21	18.60
Melons (Fall)	0.57	0	0	0	0	0	0.57	4.16	4.06	5.3	3.13	1.45	19.24
Melons (Spring)	0.14	1.52	6.07	7.14	5.64	0.84	0	0	0	0	0	0	21.35
Miscellaneous herbs	0.21	1.5	4.12	8.43	8.02	3.44	0.32	0	0	0	0	0	26.04
Moist Soil Unit	3.06	3.17	5.86	7.02	5	2.67	9.92	9.44	4.5	5.08	3.06	2.1	60.88
Oil Crops	0.21	1.5	4.12	8.43	8.02	3.44	2.06	0	0	0	0	0	27.78
Perennial Vegetables	0.57	0	1.64	3.53	7.95	7.7	8.68	8	6.61	4.77	2.83	1.75	54.03
Root Vegetables	0.59	0	0	0	0	0	0	0	0.79	1.9	2.86	2.23	8.37
Small Grains	3.06	3.74	7.09	7.44	3.58	0.28	0	0	0	0	0.07	0.95	26.21
Small Vegetables	3.27	3.23	5.45	5.54	0.93	0	0	0	0.29	2.61	2.01	2.03	25.36
Sudan	0	0	0.25	3.02	8.51	9.6	9.35	4.26	0.24	0	0	0	35.23
Sugar Beets	3.5	3.64	6.53	6.92	5.63	2.13	0.27	0	0.24	1.89	1.8	2.1	34.65
Tomatoes	0.21	1.5	4.12	8.43	8.02	3.44	0.32	0	0	0	0	0	26.04

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	3.31	3.43	6.35	7.64	9.17	8.67	9.81	8.97	7.43	5.41	3.35	2.19	75.73
All American Canal*	2.99	3.23	5.47	6.81	8.63	8.98	10.51	9.58	7.5	5.38	2.91	1.95	73.94

*Imperial to Morelos Kc data and Yuma area weather data used for these calculations

Appendix 3: Exhibits 1 through 6

This appendix contains the following Exhibits:

1. Exhibit 1. Index of water user boundaries.
2. Exhibit 2. Program area, Hoover Dam to Davis Dam.
3. Exhibit 3. Program area, Davis Dam to Parker Dam.
4. Exhibit 4. Program area, Parker Dam to Imperial Dam.
5. Exhibit 5. Program area, Imperial Irrigation District and Coachella Valley Water District.
6. Exhibit 6. Program area, Imperial Dam to Mexico, and Gila River Valley.

Exhibit 1

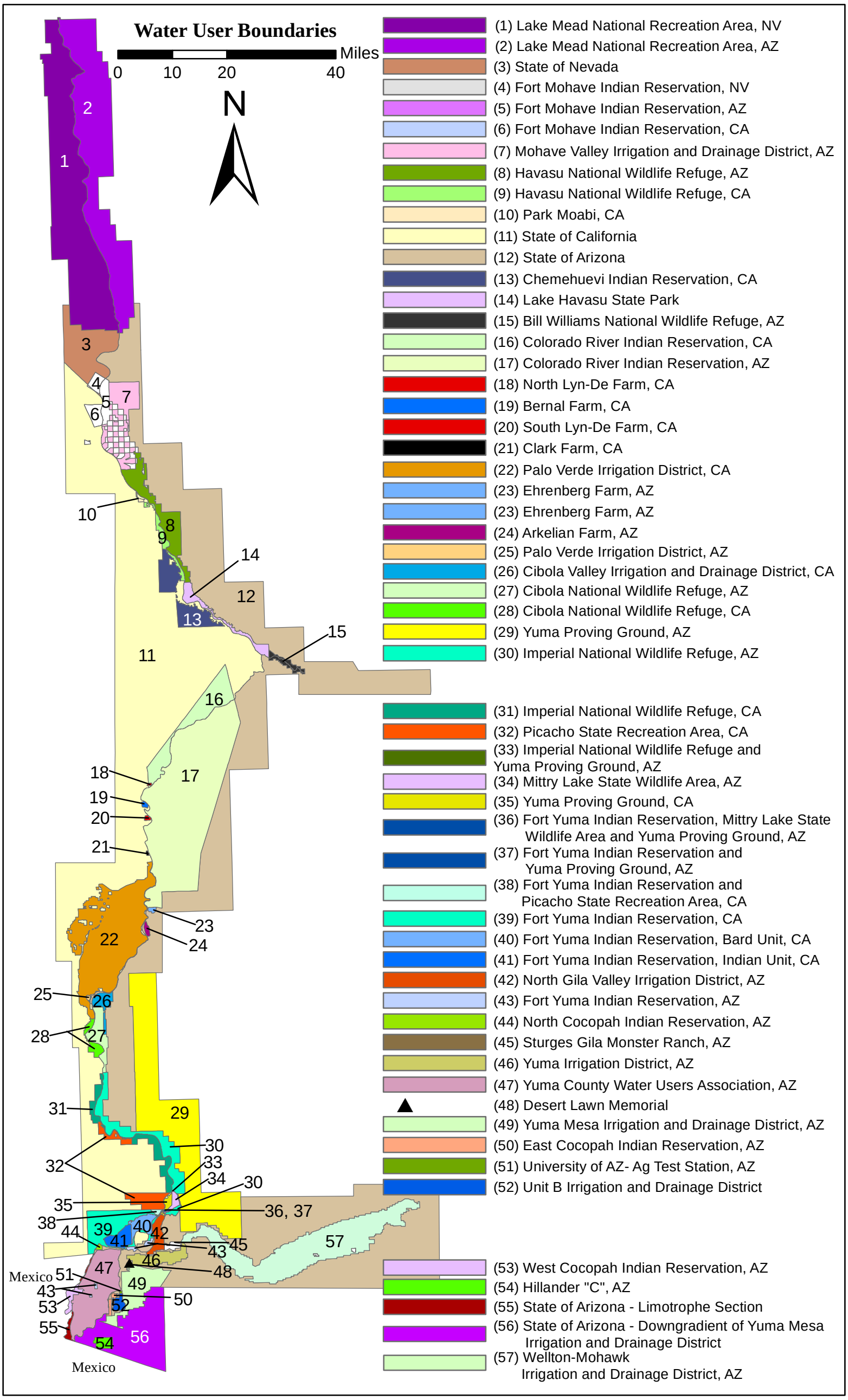

Water User Boundaries
Miles
0
10
20
40
N
(1) Lake Mead National Recreation Area, NV
(2) Lake Mead National Recreation Area, AZ
(3) State of Nevada
(4) Fort Mohave Indian Reservation, NV
(5) Fort Mohave Indian Reservation, AZ
(6) Fort Mohave Indian Reservation, CA
(7) Mohave Valley Irrigation and Drainage District, AZ
(8) Havasu National Wildlife Refuge, AZ
(9) Havasu National Wildlife Refuge, CA
(10) Park Moabi, CA
(11) State of California
(12) State of Arizona
(13) Chemehuevi Indian Reservation, CA
(14) Lake Havasu State Park
(15) Bill Williams National Wildlife Refuge, AZ
(16) Colorado River Indian Reservation, CA
(17) Colorado River Indian Reservation, AZ
(18) North Lyn-De Farm, CA
(19) Bernal Farm, CA
(20) South Lyn-De Farm, CA
(21) Clark Farm, CA
(22) Palo Verde Irrigation District, CA
(23) Ehrenberg Farm, AZ
(23) Ehrenberg Farm, AZ
(24) Arkelian Farm, AZ
(25) Palo Verde Irrigation District, AZ
(26) Cibola Valley Irrigation and Drainage District, CA
(27) Cibola National Wildlife Refuge, AZ
(28) Cibola National Wildlife Refuge, CA
(29) Yuma Proving Ground, AZ
(30) Imperial National Wildlife Refuge, AZ
(31) Imperial National Wildlife Refuge, CA
(32) Picacho State Recreation Area, CA
(33) Imperial National Wildlife Refuge and Yuma Proving Ground, AZ
(34) Mittry Lake State Wildlife Area, AZ
(35) Yuma Proving Ground, CA
(36) Fort Yuma Indian Reservation, Mittry Lake State Wildlife Area and Yuma Proving Ground, AZ
(37) Fort Yuma Indian Reservation and Yuma Proving Ground, AZ
(38) Fort Yuma Indian Reservation and Picacho State Recreation Area, CA
(39) Fort Yuma Indian Reservation, CA
(40) Fort Yuma Indian Reservation, Bard Unit, CA
(41) Fort Yuma Indian Reservation, Indian Unit, CA
(42) North Gila Valley Irrigation District, AZ
(43) Fort Yuma Indian Reservation, AZ
(44) North Cocopah Indian Reservation, AZ
(45) Sturges Gila Monster Ranch, AZ
(46) Yuma Irrigation District, AZ
(47) Yuma County Water Users Association, AZ
(48) Desert Lawn Memorial
(49) Yuma Mesa Irrigation and Drainage District, AZ
(50) East Cocopah Indian Reservation, AZ
(51) University of AZ- Ag Test Station, AZ
(52) Unit B Irrigation and Drainage District
(53) West Cocopah Indian Reservation, AZ
(54) Hillander "C", AZ
(55) State of Arizona - Limotrophe Section
(56) State of Arizona - Downgradient of Yuma Mesa Irrigation and Drainage District
(57) Wellton-Mohawk Irrigation and Drainage District, AZ
Mexico
Mexico

Exhibit 2

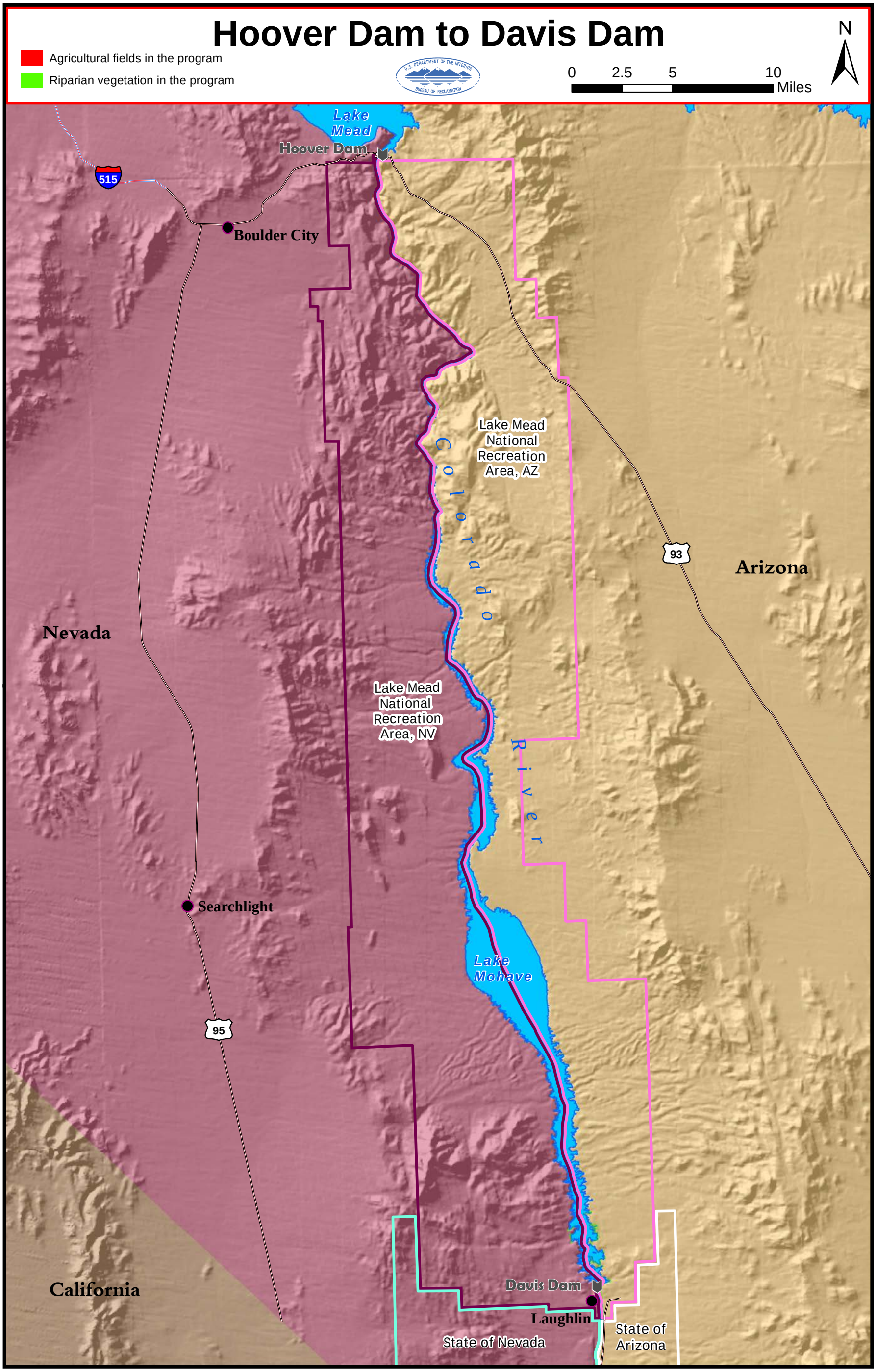

Hoover Dam to Davis Dam
Agricultural fields in the program
Riparian vegetation in the program
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
0 2.5 5 10
Miles
N
Lake Mead
Hoover Dam
515
Boulder City
Nevada
Lake Mead National Recreation Area, AZ
Colorado River
93
Arizona
Lake Mead National Recreation Area, NV
Searchlight
95
Lake Mohave
California
Davis Dam
Laughlin
State of Nevada
State of Arizona

Exhibit 3

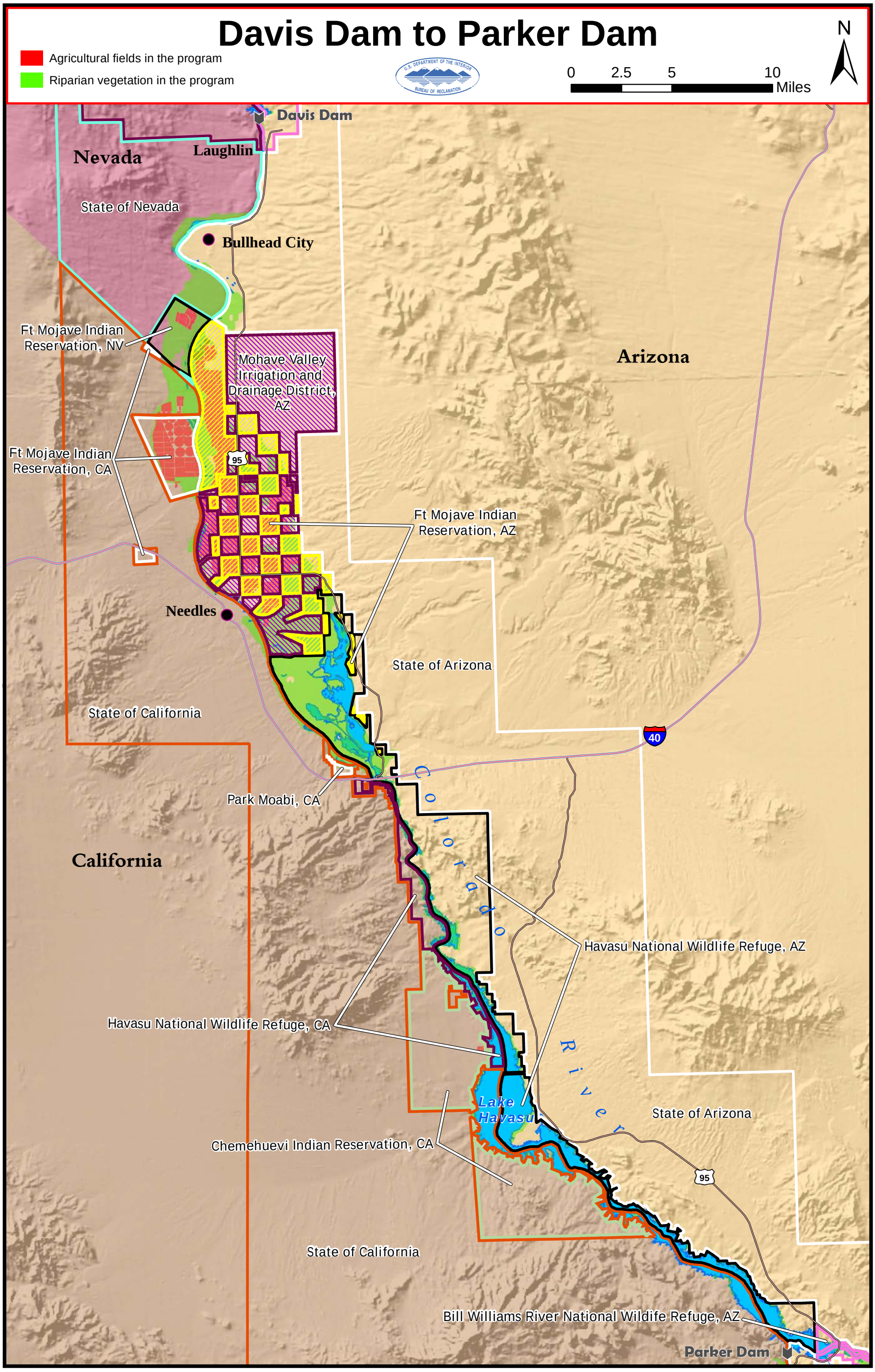

Davis Dam to Parker Dam
Agricultural fields in the program
Riparian vegetation in the program
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
0 2.5 5 10
Miles
N
Davis Dam
Nevada
Laughlin
State of Nevada
Bullhead City
Ft Mojave Indian Reservation, NV
Mohave Valley Irrigation and Drainage District, AZ
Ft Mojave Indian Reservation, CA
95
Ft Mojave Indian Reservation, AZ
Arizona
Needles
State of Arizona
State of California
40
Park Moabi, CA
Colorado River
California
Havasu National Wildlife Refuge, AZ
Havasu National Wildlife Refuge, CA
Lake Havasu
State of Arizona
Chemehuevi Indian Reservation, CA
95
State of California
Bill Williams River National Wildife Refuge, AZ
Parker Dam

Exhibit 4

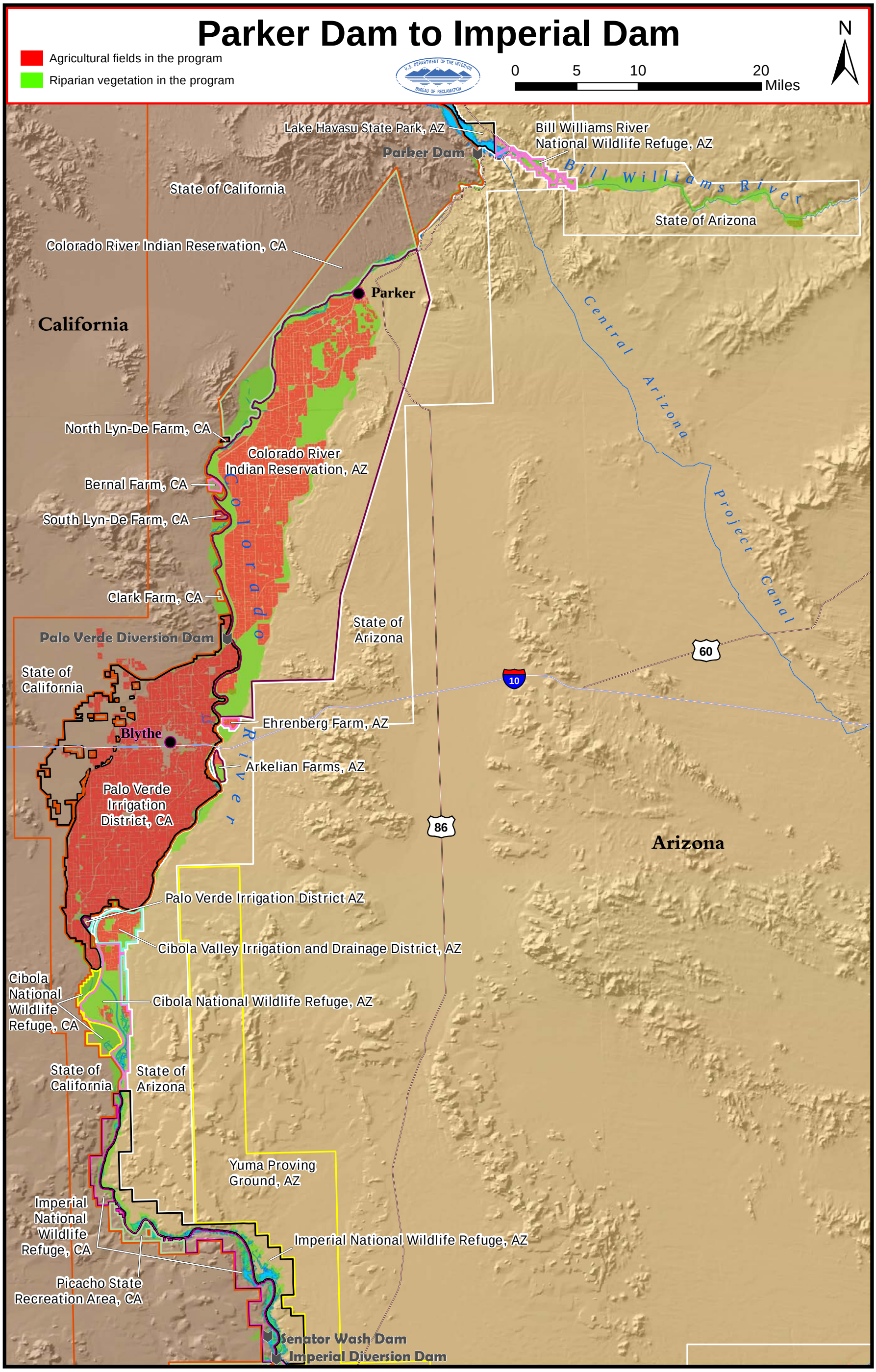

Parker Dam to Imperial Dam
Agricultural fields in the program
Riparian vegetation in the program
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
0 5 10 20
Miles
N
Lake Havasu State Park, AZ
Parker Dam
Bill Williams River
National Wildlife Refuge, AZ
Bill Williams River
State of Arizona
State of California
Colorado River Indian Reservation, CA
Parker
California
Central Arizona Project Canal
North Lyn-De Farm, CA
Colorado River
Indian Reservation, AZ
Bernal Farm, CA
South Lyn-De Farm, CA
Colorado River
Clark Farm, CA
Palo Verde Diversion Dam
State of Arizona
60
State of California
10
Blythe
Ehrenberg Farm, AZ
Colorado River
Arkelian Farms, AZ
Palo Verde Irrigation District, CA
86
Arizona
Palo Verde Irrigation District AZ
Cibola Valley Irrigation and Drainage District, AZ
Cibola
Cibola National Wildlife Refuge, AZ
Cibola National Wildlife Refuge, CA
State of California
State of Arizona
Yuma Proving Ground, AZ
Imperial National Wildlife Refuge, CA
Imperial National Wildlife Refuge, AZ
Picacho State Recreation Area, CA
Senator Wash Dam
Imperial Diversion Dam

Exhibit 5

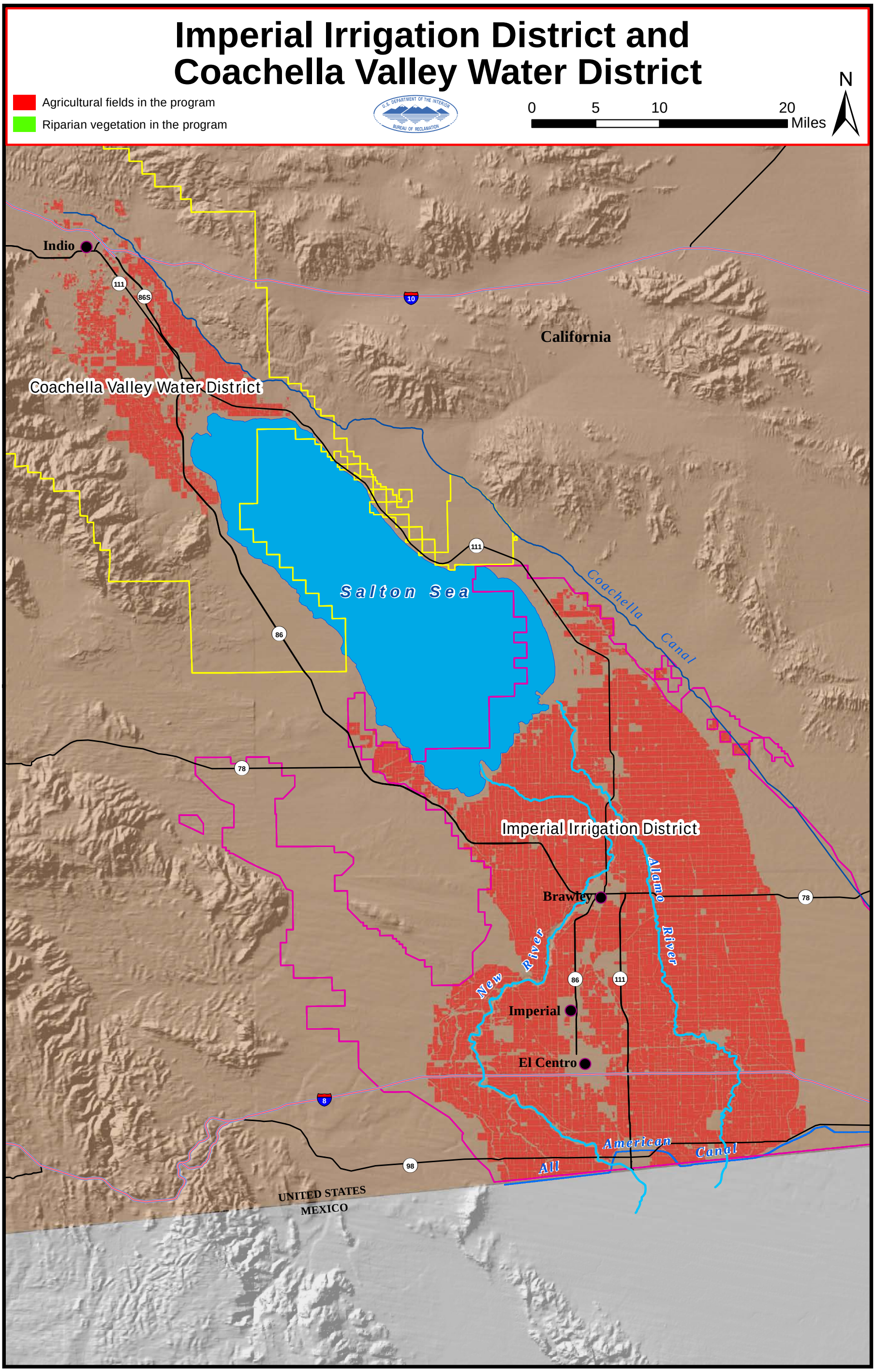
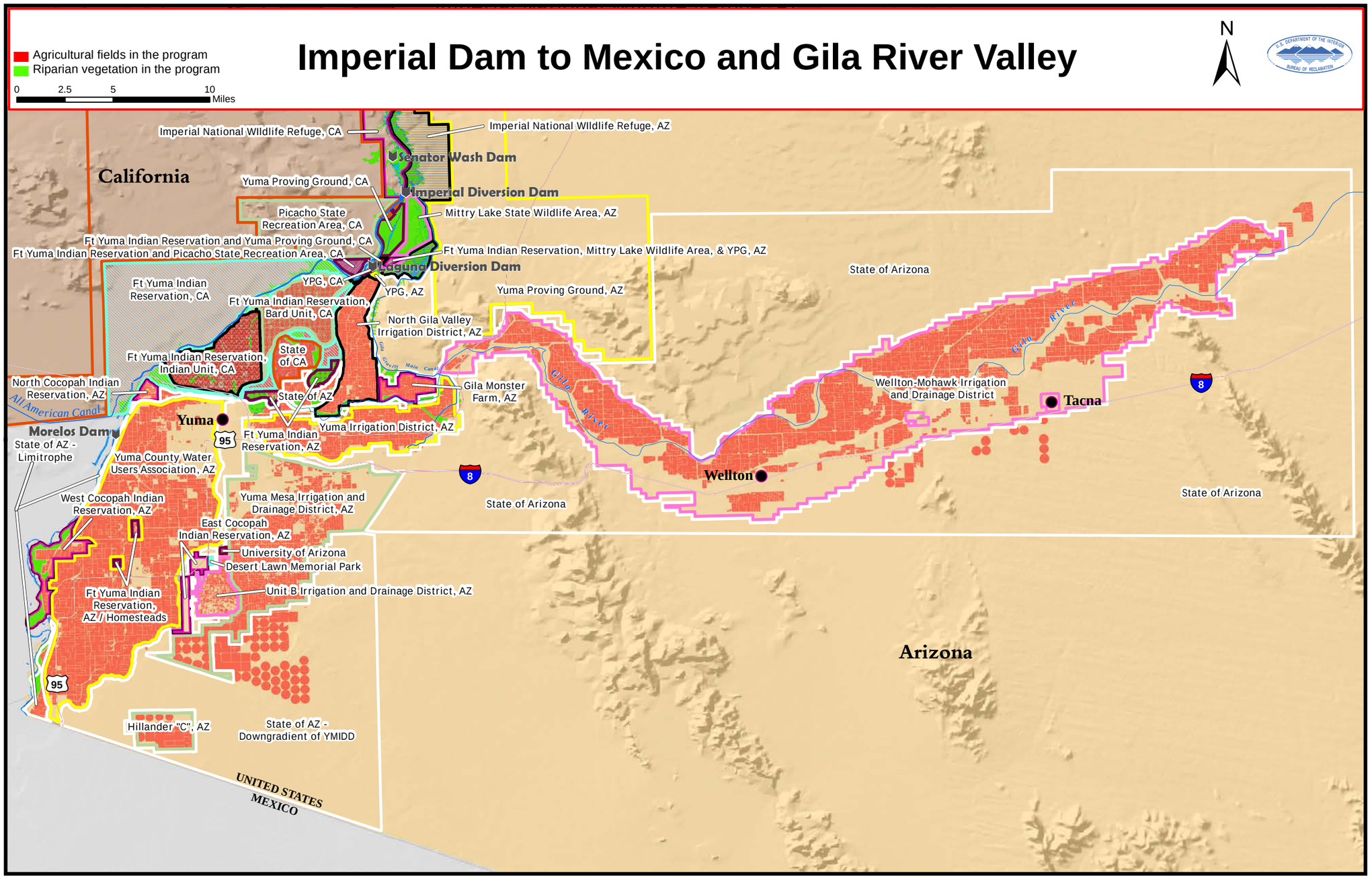

Imperial Irrigation District and
Coachella Valley Water District
Agricultural fields in the program
Riparian vegetation in the program
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
0
5
10
20
Miles
N
Indio
111
86S
10
California
Coachella Valley Water District
Salton Sea
111
Coachella Canal
86
78
Imperial Irrigation District
Brawley
78
New River
Alamo River
86
111
Imperial
El Centro
8
American Canal
All
98
UNITED STATES
MEXICO

Exhibit 6


Agricultural fields in the program
Riparian vegetation in the program
0 2.5 5 10 Miles
Imperial Dam to Mexico and Gila River Valley
N
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
California
Imperial National Wildlife Refuge, CA
Imperial National Wildlife Refuge, AZ
Senator Wash Dam
Imperial Diversion Dam
Yuma Proving Ground, CA
Picacho State Recreation Area, CA
Mittry Lake State Wildlife Area, AZ
Ft Yuma Indian Reservation and Yuma Proving Ground, CA
Ft Yuma Indian Reservation and Picacho State Recreation Area, CA
Ft Yuma Indian Reservation, Mittry Lake Wildlife Area, & YPG, AZ
Laguna Diversion Dam
YPG, CA
YPG, AZ
Ft Yuma Indian Reservation, CA
Ft Yuma Indian Reservation, Bard Unit, CA
Yuma Proving Ground, AZ
North Gila Valley Irrigation District, AZ
State of Arizona
Ft Yuma Indian Reservation, Indian Unit, CA
State of CA
North Cocopah Indian Reservation, AZ
State of AZ
Gila Monster Farm, AZ
Wellton-Mohawk Irrigation and Drainage District
Tacna
All American Canal
Yuma
Yuma Irrigation District, AZ
Morelos Dam
Ft Yuma Indian Reservation, AZ
State of AZ - Limitrophe
Yuma County Water Users Association, AZ
Wellton
West Cocopah Indian Reservation, AZ
Yuma Mesa Irrigation and Drainage District, AZ
State of Arizona
East Cocopah Indian Reservation, AZ
University of Arizona
Desert Lawn Memorial Park
Ft Yuma Indian Reservation, AZ / Homesteads
Unit B Irrigation and Drainage District, AZ
Arizona
Hillander "C", AZ
State of AZ - Downgradient of YMIDD
UNITED STATES
MEXICO
Gila River
Gila County Main Canal
95
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