

RECLAMATION

Managing Water in the West

Estimates of Evapotranspiration and Evaporation Along the Lower Colorado River

Calendar Year 2010



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

September 2014

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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.

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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.

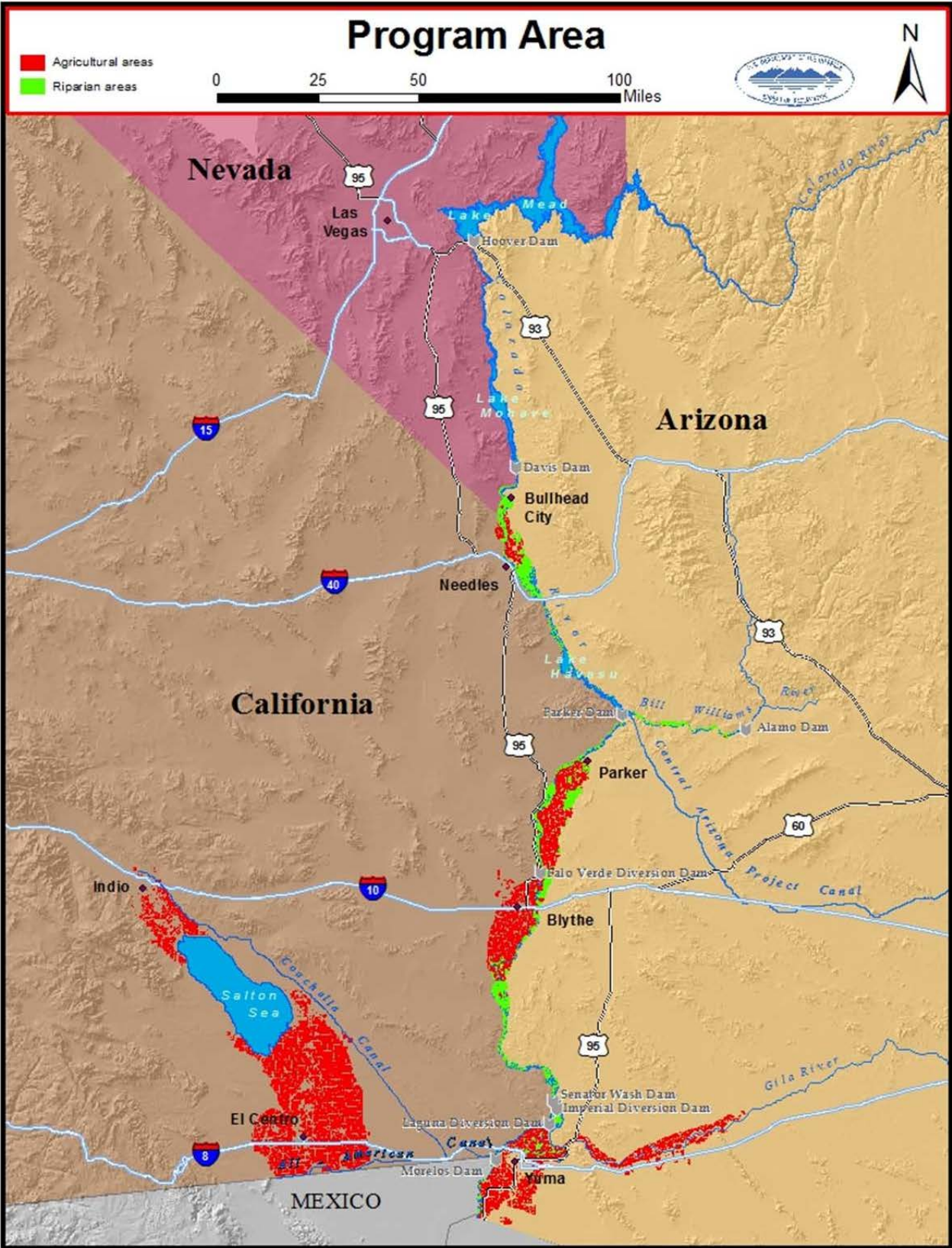
Program Area: The area in which Reclamation routinely monitors agricultural and riparian vegetation evapotranspiration and open water evaporation. Includes the lower Colorado River valley from Hoover Dam to the Southerly International Boundary with Mexico; the Wellton-Mohawk Irrigation and Drainage District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



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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.¹

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 2010 was approximately 2,765,100 acre-feet. Total estimated agricultural ET in 2009 was approximately 2,988,600 acre-feet, representing a 7.5% decrease in 2010.

Table ES-1 provides a summary of the predominant crops grown within the program area during calendar year 2010 and the acreages associated with each crop. More detailed information including water users’ agricultural acreage (irrigable, gross cropped, net cropped, and

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

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 2005-2010) of the user's total diversions, consumptive use (diversions less measured and unmeasured return flows, as reported in Reclamation's 2010 *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 2010.

Crop	Acres
Alfalfa	253,817
Lettuce (Head, Leaf Red, Leaf Green, Spinach)	157,967
Small Grains (Wheat, Oats, Rye, Barley, Millet)	116,096
Sudan (Includes Sesbania and Clover)	91,973
Bermuda/Grass (Bermuda Overseeded with Rye, Klein, Timothy)	74,336
Sugar Beets	48,037
Other (e.g. Small Vegetables, Citrus, Crucifers, Cotton, Dates, Field grains, Grapes, Melons, etc.)	218,341
Total	960,567

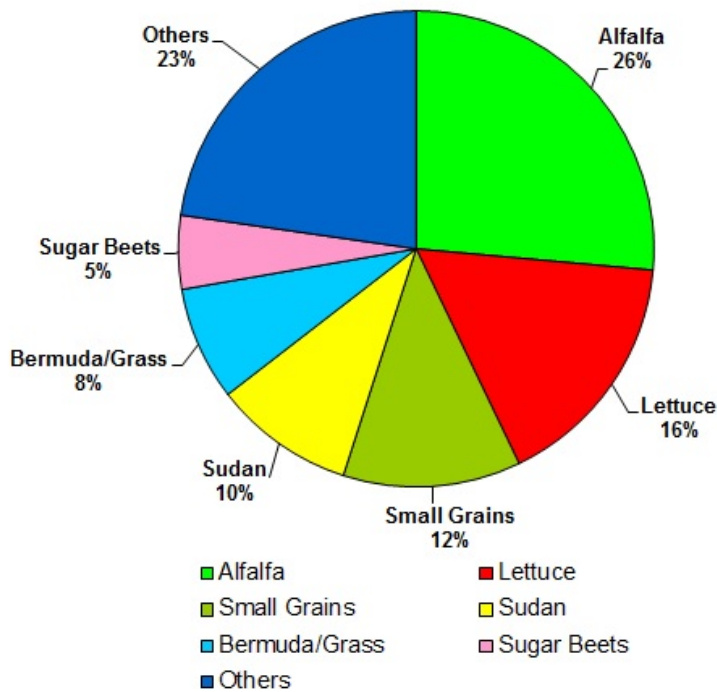


Figure ES-1. Major Crops Grown in Calendar Year 2010. (Based on Gross Cropped Acres.)

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 as 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.

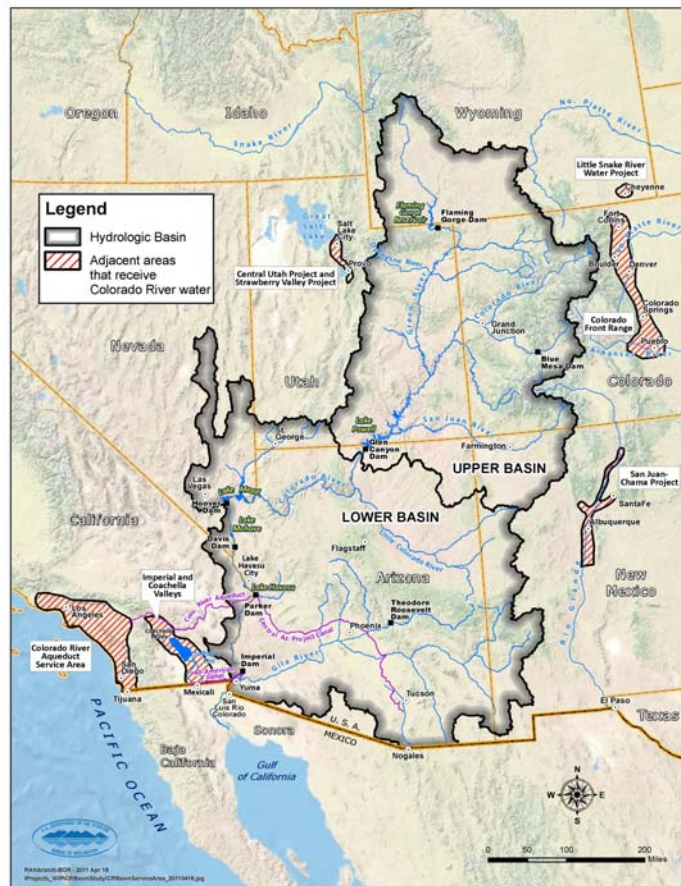


Figure 1. Map of the Colorado River hydrologic basin and areas adjacent to the hydrologic basin that receive Colorado River water.

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 the 2009 report, Reclamation 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 2010 monitoring program; and Section 5 discusses program improvements and/or changes that occurred in 2010.

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.

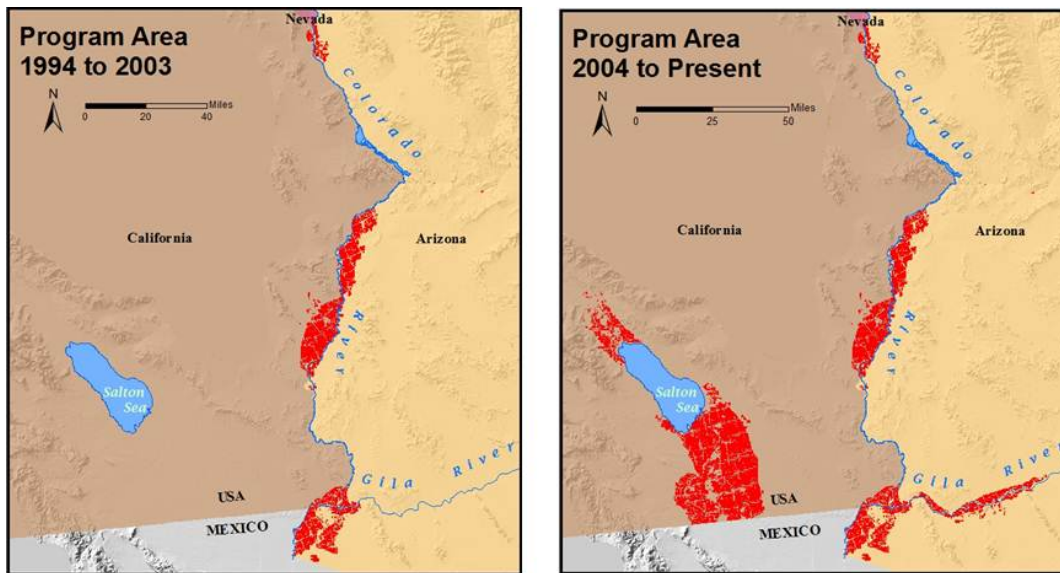


Figure 2. Program Area Extent: (1) 1994-2003 (original) and (2) 2004-Present (with the addition of WMIDD, IID, and CVWD). Program area includes riparian and open water areas, which are not shown here.

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.

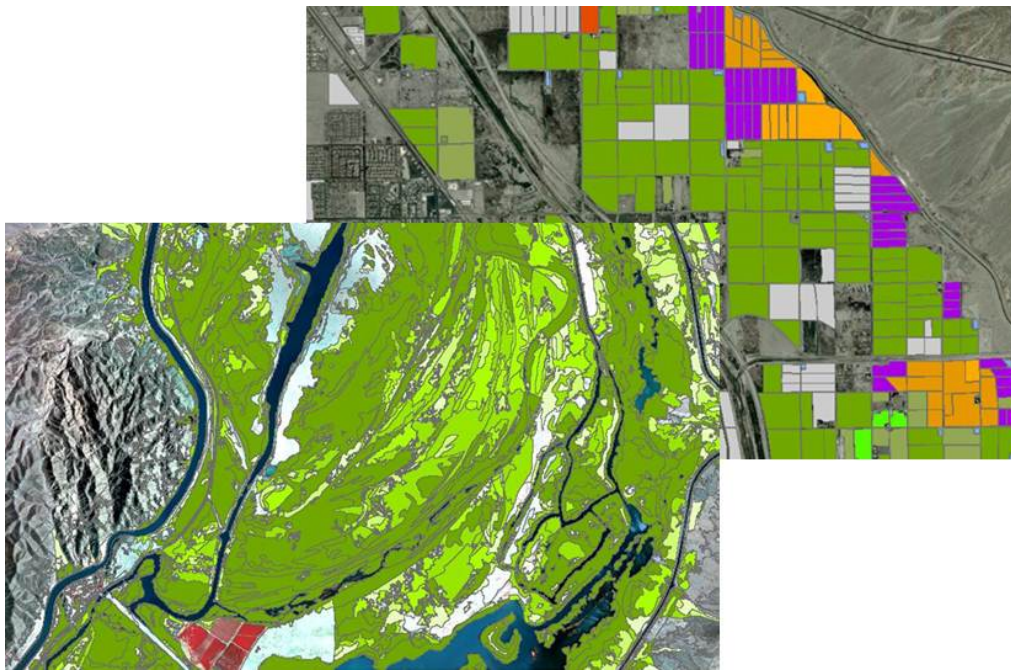


Figure 3. Reclamation uses RS and GIS processes to map crop and riparian vegetation groups and to estimate the evapotranspiration associated with these groups.

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
Jobba	Jobba
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% to 100% 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.

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 methods²). 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.



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

²See, *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 Mohave ETo	--	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 Roll ETo	--	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 Desert Resorts Airport
Yuma area	Yuma North Gila Yuma South Yuma Valley Yuma Valley ETo	--	Yuma Proving Ground Yuma Quartermaster Yuma 13.8 ESE Yuma MCAS

*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.

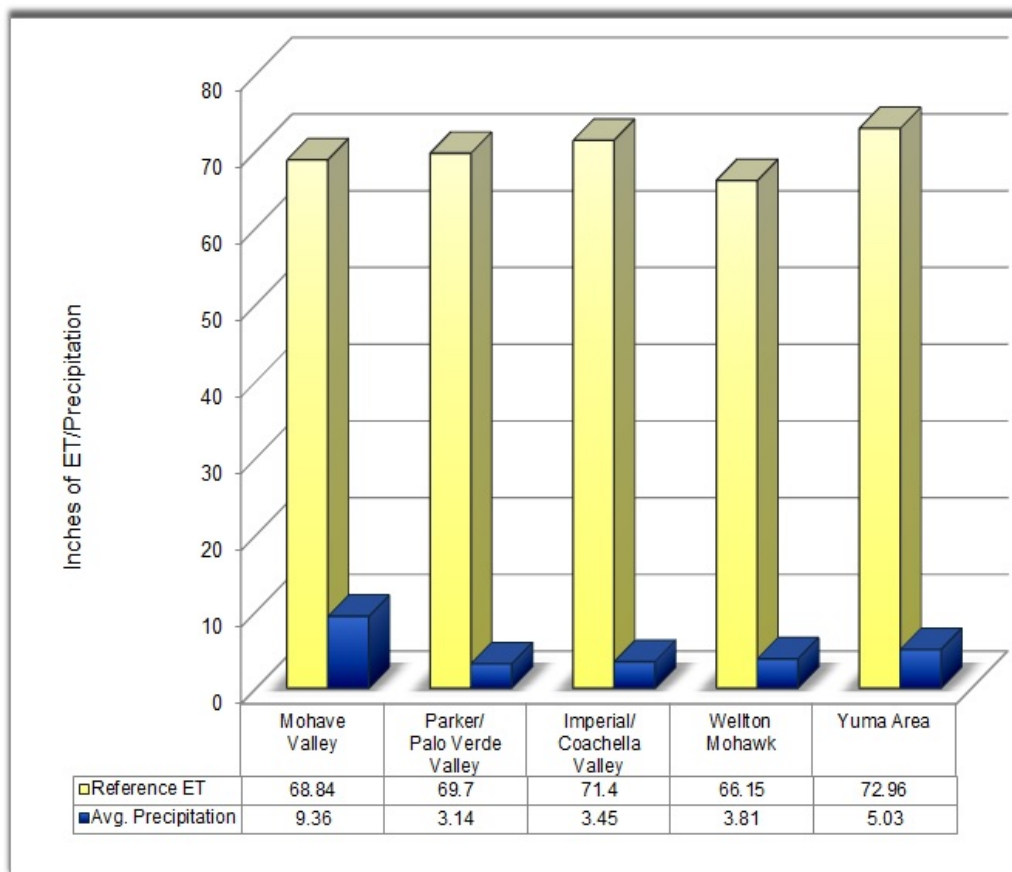


Figure 5. Reference ET and precipitation. Units: Inches.

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 the 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 Year 2008* 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:

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

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. Monthly evaporation coefficients.



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

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:

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

Where:

EVAP	=	Annual Evaporation by open water (acre-feet)
n	=	Time-step (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.

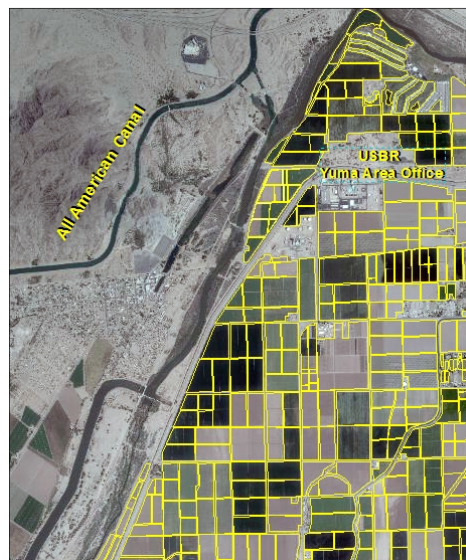


Figure 7. Digital image showing the All-American Canal, one of the canals from which Reclamation estimates evaporation.

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	1,101	3,856	55
Lake Mead National Recreation Area (Hoover Dam to Davis Dam)	0	130	205
Lake Mead National Recreation Area (Davis Dam to Parker Dam)	0	60	0
State of Nevada	0	7,529	241
Nevada Totals*	1,101	11,576	502
California			
Bernal Farm	0	706	0
Chemehuevi Indian Reservation	0	29	0
Cibola National Wildlife Refuge	0	10,855	824
Clark Farm	28	76	0
Coachella Valley Water District	153,872	0	5,521
Colorado River Indian Reservation	0	21,063	367
Fort Mojave Indian Reservation	10,277	3,079	0
Fort Yuma Indian Reservation and Picacho State Recreation Area	0	30	0
Fort Yuma Indian Reservation and Yuma Proving Ground	0	471	1
Fort Yuma Indian Reservation	1,367	8,165	222
Havasu National Wildlife Refuge	0	4,730	1,084
Imperial Irrigation District	1,448,441	0	10,457
Imperial National Wildlife Refuge and Yuma Proving Ground	0	26	0
Imperial National Wildlife Refuge (Imperial Dam to Mexico)	0	28	0
Imperial National Wildlife Refuge (Parker Dam to Imperial Dam)	0	15,556	5,160
Moabi Regional Park	0	148	0
North Lyn-de Farm	648	0	0

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

Water User	Agricultural ET	Riparian Vegetation ET³	Open Water Evaporation
Palo Verde Irrigation District	231,342	5,192	1,008
Picacho State Recreation Area (Imperial Dam to Mexico)	0	712	11
Picacho State Recreation Area (Parker Dam to Imperial Dam)	0	3,273	486
South Lyn-de Farm	694	0	0
State of California (Other users, Davis Dam to Parker Dam)	0	10,735	365
State of California (Other users, Imperial Dam to Mexico)	1,562	1,747	229
State of California (Other users, Parker Dam to Imperial Dam)	1,800	17,679	1,589
Yuma Project Reservation Division, Bard Unit	19,359	558	170
Yuma Project Reservation Division, Indian Unit	15,034	882	120
Yuma Proving Ground	0	5,577	21
California Totals*	1,884,424	111,321	27,635
Arizona			
Arkelian Farm	1,467	1,568	0
Bill Williams National Wildlife Refuge	0	7,646	0
Cibola National Wildlife Refuge	9,110	23,680	2,699
Cibola Valley Irrigation and Drainage District	13,250	5,145	3
Colorado River Indian Reservation	325,858	77,170	1,089
East Cocopah Reservation	0	0	0
Ehrenberg Farm	3,277	0	0
Fort Mojave Indian Reservation	33,539	19,466	158
Fort Yuma Indian Reservation & Homesteads	735	2,168	22
Fort Yuma Indian Reservation, Mittry State Wildlife Area and Yuma Proving Ground	0	774	179
Gila Monster Farms	4,479	710	112
Havasas National Wildlife Refuge	321	35,465	15,320
Havasas State Park (Windsor Beach)	0	2,290	0
Imperial National Wildlife Refuge (Imperial Dam to Mexico)	145	4,435	2,325
Imperial National Wildlife Refuge (Parker Dam to Imperial Dam)	0	24,005	6,158

Water User	Agricultural ET	Riparian Vegetation ET³	Open Water Evaporation
Lake Mead National Recreation Area (Davis Dam to Parker Dam)	0	224	292
Lake Mead National Recreation Area (Hoover Dam to Davis Dam)	0	345	32
Mittry Lake State Wildlife Area	99	6,850	489
Mohave Valley Irrigation and Drainage District	21,434	14,932	611
North Cocopah Indian Reservation	986	13	50
North Gila Valley Irrigation District	19,018	1,379	48
Palo Verde Irrigation District	425	352	237
State of Arizona (Other users, Davis Dam to Parker Dam)	0	2,466	0
State of Arizona (Other users, Imperial Dam to Mexico)	9,785	8,476	373
State of Arizona (Other users, Parker Dam to Imperial Dam)	0	14,154	600
State of Arizona-Down Gradient from Yuma Mesa Irrigation and Drainage District	25,302	0	0
State of Arizona-Limitrophe Section	2,203	2,031	22
Unit "B" Irrigation and Drainage District	6,597	0	120
University of Arizona Agricultural Station	214	0	0
Wellton-Mohawk Irrigation and Drainage District	187,633	2	722
West Cocopah Indian Reservation	423	3,989	10
Yuma County Water Users Association	110,842	5	1,869
Yuma Irrigation District	28,520	463	366
Yuma Mesa Irrigation and Drainage District	62,573	0	1,030
Yuma Proving Ground, AZ Total	0	381	0
Arizona Totals*	868,239	260,584	34,937
Hoover Dam to Mexico Totals*	2,753,764	383,480	63,074

*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	66,672	587,900	2,099,192	2,753,765
Riparian Vegetation ³	474	112,657	220,474	49,875	383,480
Evaporation – Open Water	237	18,128	20,220	24,489	63,074
Evaporation – Mainstream	126,813	92,906	49,248	5,539	274,507

*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 Valley⁵, and South Yuma Mesa⁶. 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	1,252	16,215	301
State of Arizona – Gila River Valley	5,183	15	0
Hillander C Irrigation District	4,941	0	0
Totals	11,376	16,229	301

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 2005-2010) of the user's total diversions and consumptive use (as reported in Reclamation's 2010 *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.

The raw data used to develop the results presented in Tables 4 through 6 can be found on Reclamation's website at <http://www.usbr.gov/lc/region/g4000/wtracct.html>.

5.0 Program Improvements for Calendar Year 2010

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 the program improvements implemented for calendar year 2010.

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 adjusted riparian vegetation ET coefficients in 2010 based on this study. These coefficients generally reduce ET estimates in riparian vegetation by 30 to 40%.

5.2 Adjusting Water User Boundaries

For calendar year 2010, 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 2010 NAIP for agricultural lands in California. This high-resolution imagery was not available in 2010 for agricultural lands in Arizona. In addition, 30-m resolution LANDSAT satellite imagery was used to identify areas of large (>1800m²) changes in open water surface area not identifiable using 2010 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).

5.4 Improving Crop ET Estimates

For calendar year 2010, Reclamation updated average crop coefficient curves for select crops to better represent the variability in planting and harvesting dates. The following crop coefficient curves were adjusted:

1. Crucifer curves were adjusted to represent both early and late planting and harvesting.
2. Lettuce curves were adjusted to represent both early and late planting and harvesting.
3. Small vegetable curves were adjusted to represent both early and late planting and harvesting.

Implementing this change results in improved ET estimates for these crops.

6.0 References

- Bureau of Reclamation. 1997. *Lower Colorado River Accounting System, Calendar Year 1995, Demonstration of Technology Report*.
- Bureau of Reclamation. 2002. *Lower Colorado River Accounting System, Calendar Year 2001, Demonstration of Technology Report*.
- Bureau of Reclamation. 2006. *Lower Colorado River Accounting System Evapotranspiration and Evaporation Calculations, Calendar Year 2004*.
- Bureau of Reclamation. 2009. *Lower Colorado River Accounting System Evapotranspiration and Evaporation Calculations, Calendar Year 2008*.
- ESRI, Inc. 1994. *Understanding GIS: The ARC/INFO Method*.
- 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).
- Jensen, Marvin E. 1998. *Coefficients for Vegetative Evapotranspiration and Open-Water Evaporation for the Lower Colorado River Accounting System*. (Copies available from the Bureau of Reclamation, Boulder Canyon Operations Office, Boulder City, Nevada).
- Jensen, Marvin E. 2003. *Vegetative and Open Water Coefficients for the Lower Colorado River Accounting System (LCRAS) Addendum to the 1998 Report*. (Copies available from the Bureau of Reclamation Boulder Canyon Operations Office in Boulder City, Nevada).
- 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.
- United States Geological Survey. 2006. "Evapotranspiration by Phreatophytes Along the Lower Colorado River at Havasu National Wildlife Refuge, Arizona." *Scientific Investigations Report 2006-5043*.

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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 2005-2010) 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

2010

Agriculture

There is no agricultural use in this reach.

Riparian

Riparian Vegetation Acres:	320
Riparian Evapotranspiration (acre-feet):	474

Open Water

Open Water Acres:	51
Open Water Evaporation (acre-feet):	237

Mainstream (Lake and River)

Acres:	27,360
Evaporation (acre-feet):	126,813



Water Users within Reach

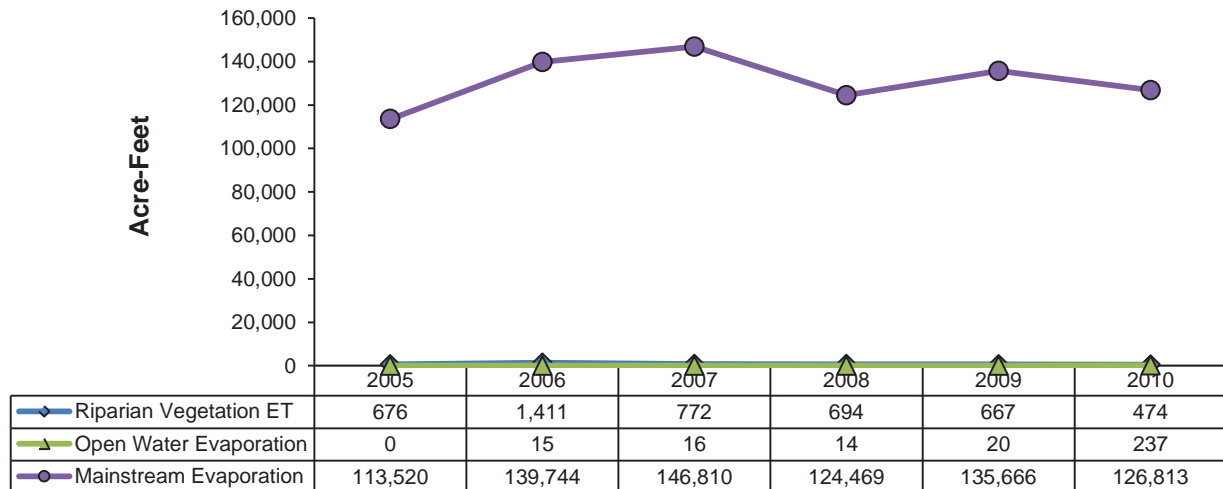
Lake Mead National Recreation Area - AZ & NV

Crop Types within Reach

Acres Annual ET (acre-feet)

Note: There were no crops grown in this reach.

Evapotranspiration and Evaporation, 2005-2010



Davis Dam to Parker Dam

2010

Agriculture

Irrigable Acres:	18,326
Gross Cropped Acres:	17,490
Net Cropped Acres:	17,178
Fallowed/Idle Acres:	1,148
Agricultural Evapotranspiration (acre-feet):	66,672

Riparian

Riparian Vegetation Acres:	45,706
Riparian Evapotranspiration (acre-feet):	112,657

Open Water

Open Water Acres:	3,911
Open Water Evaporation (acre-feet):	18,128

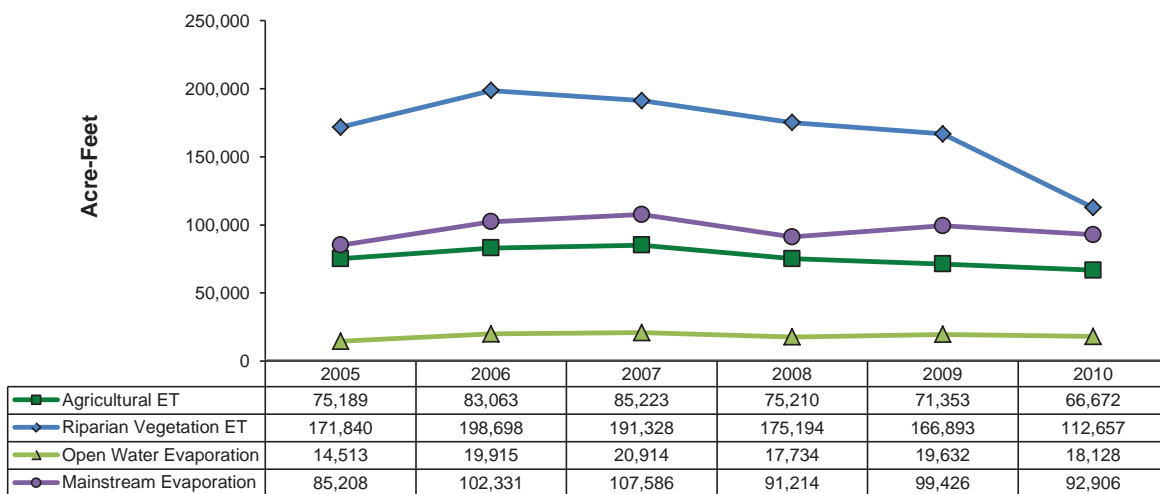
Mainstream (Lake and River)

Acres:	20,045
Evaporation (acre-feet):	92,906



Water Users within Reach	Crop Types within Reach	Acres	Annual ET (acre-feet)
Bill Williams River National Wildlife Refuge - AZ	Alfalfa	9,165	46,459
Chemehuevi Indian Reservation - CA	Bermuda/Grass	1,195	3,739
Fort Mojave Indian Reservation - AZ, CA, & NV	Cotton	5,331	14,444
Havasu National Wildlife Refuge - AZ & CA	Melons	13	20
Havasu State Park (Windsor Beach) - AZ	Small Grains	1,763	1,932
Lake Mead National Recreation Area - AZ & NV	Sudan	23	78
Moabi Regional Park - CA			
Mohave Valley Irrigation & Drainage District - AZ			
State of AZ (Other Users)			
State of AZ, Alamo Dam to Bill Williams River NWR - AZ*			
State of CA (Other Users)			
State of NV (Other Users)			
Total		17,490	66,672

Evapotranspiration and Evaporation, 2005-2010



*The origin of water used for agricultural 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

2010

Agriculture

Irrigable Acres:	174,071
Gross Cropped Acres:	131,441
Net Cropped Acres:	142,120
Fallowed/Idle Acres:	31,951
Agricultural Evapotranspiration (acre-feet):	587,900

Riparian

Riparian Vegetation Acres:	89,421
Riparian Evapotranspiration (acre-feet):	220,474

Open Water

Open Water Acres:	3,927
Open Water Evaporation (acre-feet):	20,220

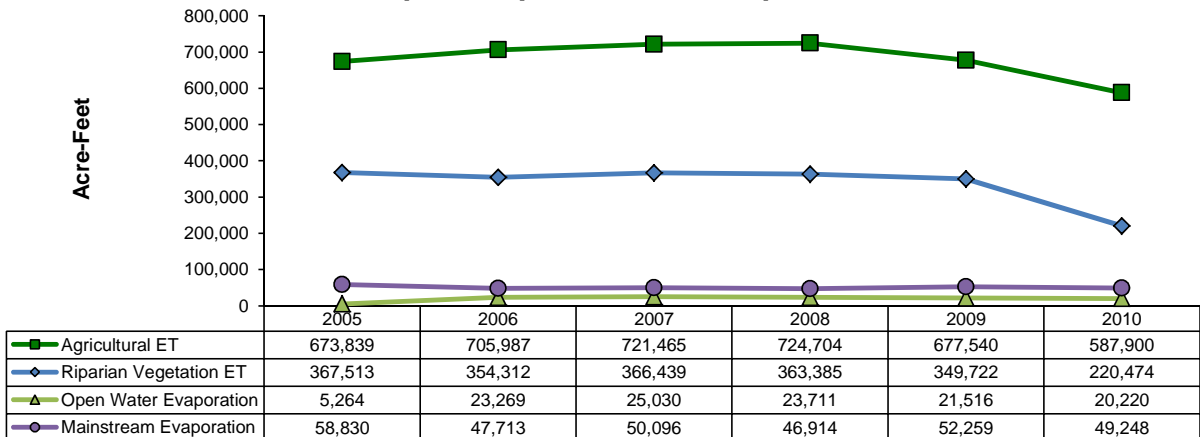
Mainstream (Lake and River)

Acres:	9,542
Evaporation (acre-feet):	49,248



Water Users within Reach	Crop Types within Reach	Acres	Annual ET (acre-feet)
Arkelian Farm - AZ	Alfalfa	91,991	475,130
Bernal Farm - CA	Bermuda/Grass	3,862	12,269
Cibola National Wildlife Refuge - AZ & CA	Citrus	2,014	6,713
Cibola Valley Irrigation & Drainage District - AZ	Cotton	18,657	53,588
Clark Farm - CA	Crucifers	1,279	641
Colorado River Indian Reservation - AZ & CA	Dates	408	2,269
Ehrenberg Farm, AZ	Deciduous Orchards	1,598	7,295
Imperial National Wildlife Refuge - AZ & CA	Field Grain	208	489
North Lyn-de Farm - CA	Grapes	92	274
Palo Verde Irrigation District - AZ & CA	Lettuce	417	226
Picacho State Recreation Area - CA	Melons	2,086	3,720
South Lyn-de Farm - CA	Moist Soil Unit	291	1,433
State of AZ (Other Users)	Nursery/Greenhouse	9	18
State of CA (Other Users)	Perennial Vegetables	434	1,925
	Small Grains	3,133	5,048
	Sudan	4,961	16,863
	Total	131,441	587,900

Evapotranspiration and Evaporation, 2005-2010



Imperial Dam to Mexico

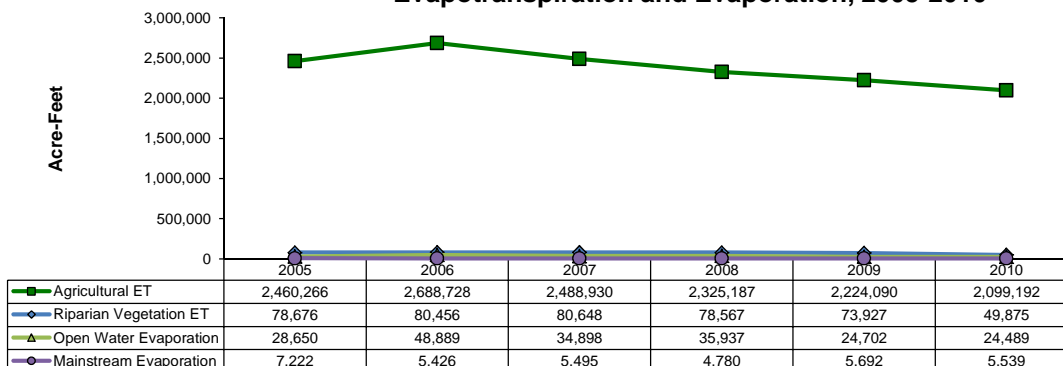
2010

Agriculture	
Irrigable Acres:	653,512
Gross Cropped Acres:	811,637
Net Cropped Acres:	604,404
Fallowed/Idle Acres:	49,108
Agricultural Evapotranspiration (acre-feet):	2,099,192
Riparian	
Riparian Vegetation Acres:	19,193
Riparian Evapotranspiration (acre-feet):	49,875
Open Water	
Open Water Acres:	4,010
Open Water Evaporation (acre-feet):	24,489
Mainstream (Lake and River)	
Acres:	924
Evaporation (acre-feet):	5,539



Water Users within Reach	Crop Types within Reach	Acres	Annual ET (acre-feet)
Coachella Valley Water District - CA	Alfalfa	152,660	773,721
Cocopah Indian Reservation (East, West & North) - AZ	Aloe	73	154
Fort Yuma Indian Reservation & Picacho State Recreation Area - CA	Bermuda/Grass	69,280	299,399
Fort Yuma Indian Reservation & Yuma Proving Ground - CA	Cane/Bamboo	391	2,251
Fort Yuma Indian Reservation & Homesteads - AZ	Citrus	23,761	79,257
Fort Yuma Indian Reservation, Bard Unit - CA	Cotton	15,825	51,769
Fort Yuma Indian Reservation - CA	Crucifers	41,155	27,391
Fort Yuma Indian Reservation, Indian Unit - CA	Dates	13,413	76,368
Fort Yuma Indian Reservation, Mittry State Wildlife Area & YPG -AZ	Deciduous Orchards	913	4,094
Gila Monster Farms - AZ	Field Grain	13,634	38,141
Hillander C Irrigation District - AZ*	Grapes	8,131	24,791
Imperial Irrigation District - CA	Legume/Solanum Veg.	11,036	17,237
Imperial National Wildlife Refuge - AZ & CA	Lettuce	157,550	78,013
Imperial National Wildlife Refuge and Yuma Proving Ground - CA	Melons	11,405	18,832
Mittry Lake State Wildlife Area - AZ	Miscellaneous herbs	1,556	3,576
North Gila Valley Irrigation & Drainage District - AZ	Moist Soil Unit	1,772	8,833
State of AZ (Other Users)	Nursery/Greenhouse	2,533	5,393
State of AZ - Wellton Mohawk Area - AZ*	Oil Crops	42	110
State of AZ - Down Gradient from YMIDD	Perennial Vegetables	610	847
State of AZ - Limitrophe Section	Root Vegetables	354	249
State of CA (Other Users)	Small Grains	111,200	193,052
Unit "B" Irrigation & Drainage District - AZ	Small Vegetables	38,633	45,152
University of Arizona Agricultural Station - AZ	Sudan	86,990	279,629
Yuma County Water Users Association - AZ	Sugar Beets	48,037	69,521
Yuma Irrigation District - AZ	Tomatoes	181	395
Yuma Mesa Irrigation & Drainage District - AZ	Wildlife Forage Maintained	502	1,017
Yuma Proving Ground - AZ & CA	Total	811,637	2,099,192
Wellton-Mohawk Irrigation & Drainage District - AZ			

Evapotranspiration and Evaporation, 2005-2010



*The origin of water used for agricultural 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

2010

River Reach: Parker Dam to Imperial Dam

Agriculture

Irrigable Acres:	2,337
Gross Cropped Acres:	2,041
Net Cropped Acres:	2,260
Fallowed/Idle Acres:	77
Agricultural Evapotranspiration (acre-feet):	9,110

Riparian

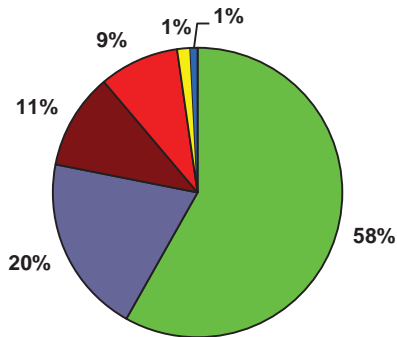
Riparian Vegetation Acres:	9,498
Riparian Evapotranspiration (acre-feet):	23,680

Open Water

Open Water Acres:	533
Open Water Evaporation (acre-feet):	2,699

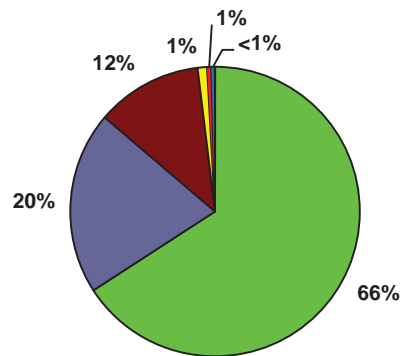


Major Crop Types

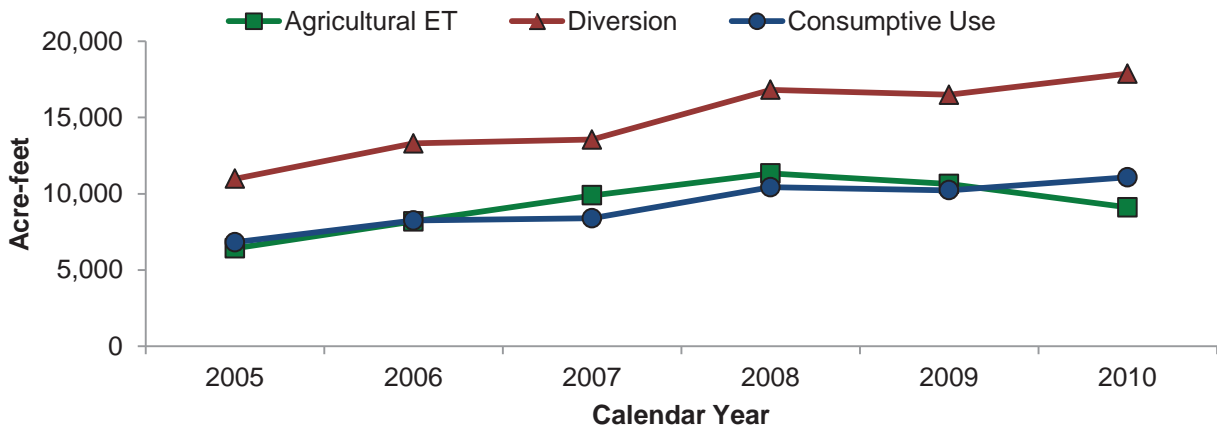


- Alfalfa
- Deciduous Orchards
- Moist Soil Unit
- Small Grains
- Bermuda/Grass
- Others

Annual Agricultural ET



- Alfalfa
- Deciduous Orchards
- Moist Soil Unit
- Small Grains
- Bermuda/Grass
- Others



Cibola National Wildlife Refuge - AZ

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	1,188	58	5,999	66
Bermuda/Grass	30	1	95	1
Deciduous Orchards	407	20	1,858	20
Field Grain	16	<1	39	<1
Moist Soil Unit	219	11	1,077	12
Small Grains	182	9	42	<1
Total*	2,041	100%	9,110	100%

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

Cibola Valley Irrigation and Drainage District - AZ

2010

River Reach: Parker Dam to Imperial Dam

Agriculture

Irrigable Acres:	3,744
Gross Cropped Acres:	3,398
Net Cropped Acres:	3,382
Fallowed/Idle Acres:	362
Agricultural Evapotranspiration (acre-feet):	13,250

Riparian

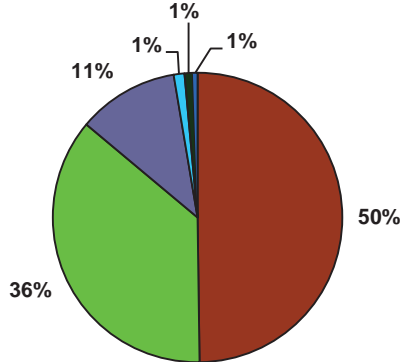
Riparian Vegetation Acres:	1,832
Riparian Evapotranspiration (acre-feet):	5,145

Open Water

Open Water Acres:	1
Open Water Evaporation (acre-feet):	3

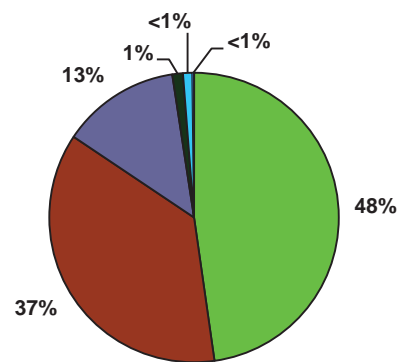


Major Crop Types

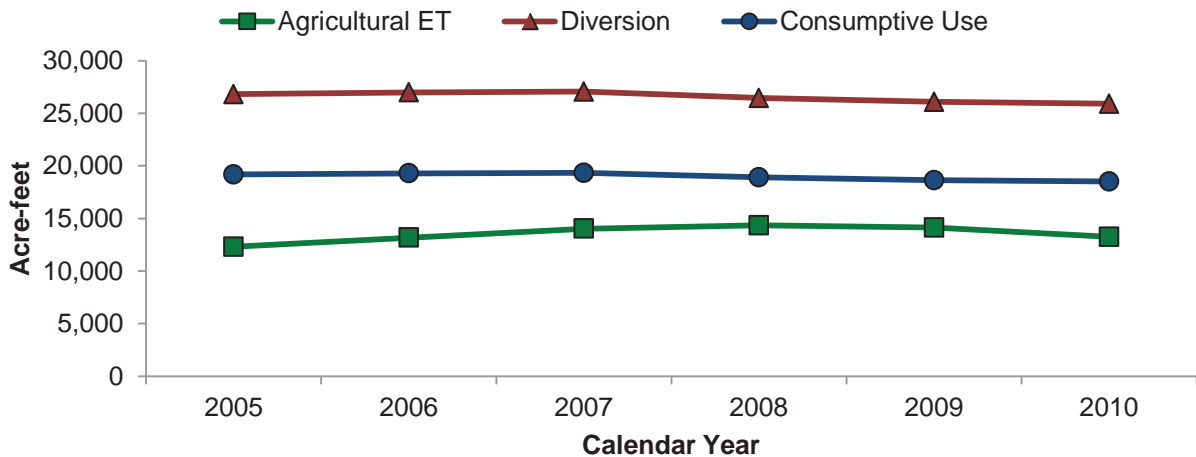


- Cotton
- Alfalfa
- Deciduous Orchards
- Sudan
- Moist Soil Unit
- Others

Annual Agricultural ET



- Alfalfa
- Cotton
- Deciduous Orchards
- Moist Soil Unit
- Sudan
- Others



Cibola Valley Irrigation and Drainage District - AZ 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	1,234	36	6,325	48
Bermuda/Grass	18	<1	25	<1
Cotton	1,692	50	4,859	37
Deciduous Orchards	383	11	1,748	13
Moist Soil Unit	32	<1	156	1
Sudan	40	1	137	1
Total*	3,398	100%	13,250	100%

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

Cocopah Indian Reservation - AZ

(Includes East, North and West Reservations)

2010

River Reach: Imperial Dam to Mexico

Agriculture

Irrigable Acres:	1,908
Gross Cropped Acres:	1,047
Net Cropped Acres:	893
Fallowed/Idle Acres:	1,015
Agricultural Evapotranspiration (acre-feet):	1,410

Riparian

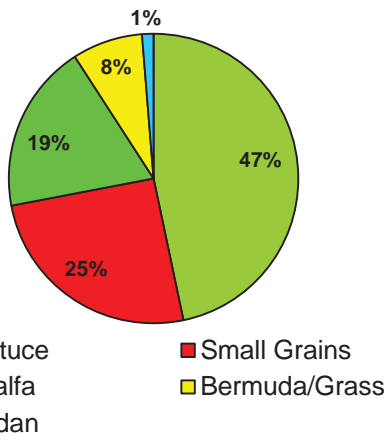
Riparian Vegetation Acres:	1,509
Riparian Evapotranspiration (acre-feet):	4,003

Open Water

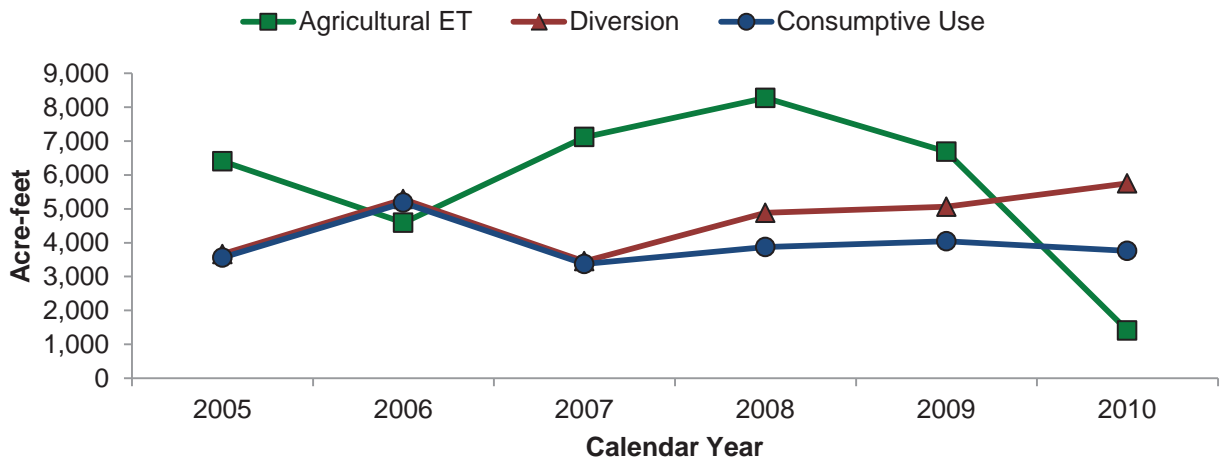
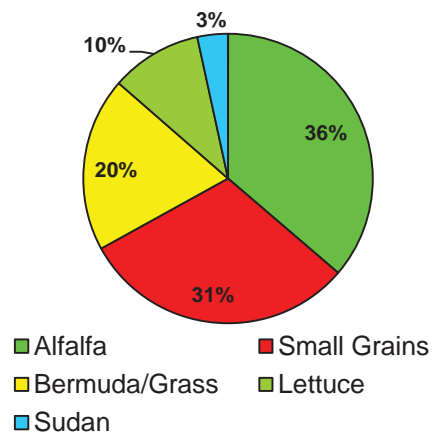
Open Water Acres:	10
Open Water Evaporation (acre-feet):	60



Major Crop Types



Annual Agricultural ET



Cocopah Indian Reservation - AZ

(Includes East, North and West Reservations)

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	198	19	511	36
Bermuda/Grass	82	8	274	19
Lettuce	489	47	143	10
Small Grains	265	25	433	31
Sudan	13	1	48	3
Total*	1,047	100%	1,410	100%

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

Colorado River Indian Reservation - AZ 2010

River Reach: Parker Dam to Imperial Dam

Agriculture

Irrigable Acres:	75,011
Gross Cropped Acres:	68,652
Net Cropped Acres:	71,633
Fallowed/Idle Acres:	3,378
Agricultural Evapotranspiration (acre-feet):	325,858

Riparian

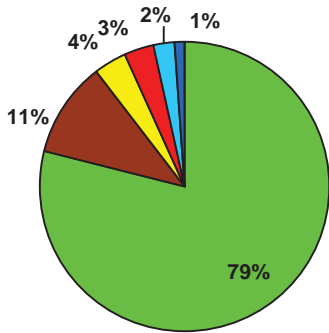
Riparian Vegetation Acres:	33,301
Riparian Evapotranspiration (acre-feet):	77,170

Open Water

Open Water Acres:	211
Open Water Evaporation (acre-feet):	1,089

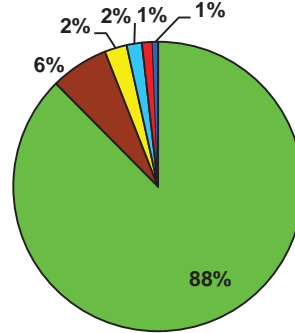


Major Crop Types

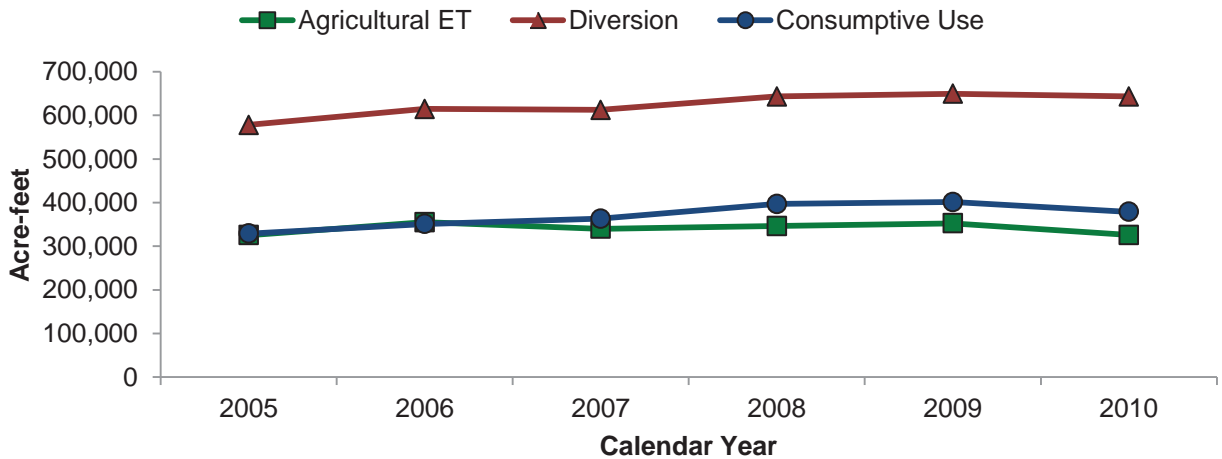


- Alfalfa
- Cotton
- Bermuda/Grass
- Small Grains
- Sudan
- Others

Annual Agricultural ET



- Alfalfa
- Cotton
- Bermuda/Grass
- Small Grains
- Sudan
- Others



Colorado River Indian Reservation - AZ

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	54,191	79	284,066	87
Bermuda/Grass	2,518	4	8,058	2
Cotton	7,300	11	20,967	6
Deciduous Orchards	319	<1	1,454	<1
Field Grain	3	<1	6	<1
Grapes	5	<1	14	<1
Perennial Vegetables	434	<1	1,925	<1
Small Grains	2,266	3	3,876	1
Sudan	1,615	2	5,492	2
Total*	68,652	100%	325,858	100%

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

Fort Mojave Indian Reservation - AZ

2010

River Reach: Davis Dam to Parker Dam

Agriculture

Irrigable Acres:	8,989
Gross Cropped Acres:	8,605
Net Cropped Acres:	8,835
Fallowed/Idle Acres:	154
Agricultural Evapotranspiration (acre-feet):	33,539

Riparian

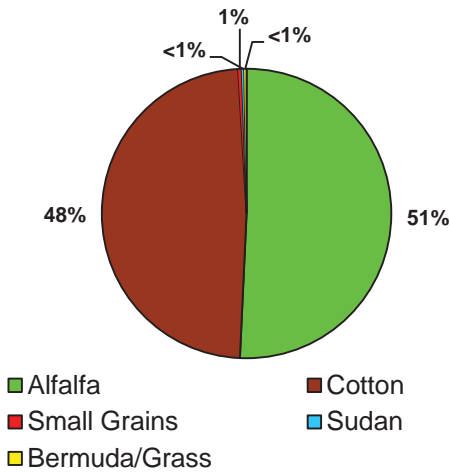
Riparian Vegetation Acres:	8,131
Riparian Evapotranspiration (acre-feet):	19,466

Open Water

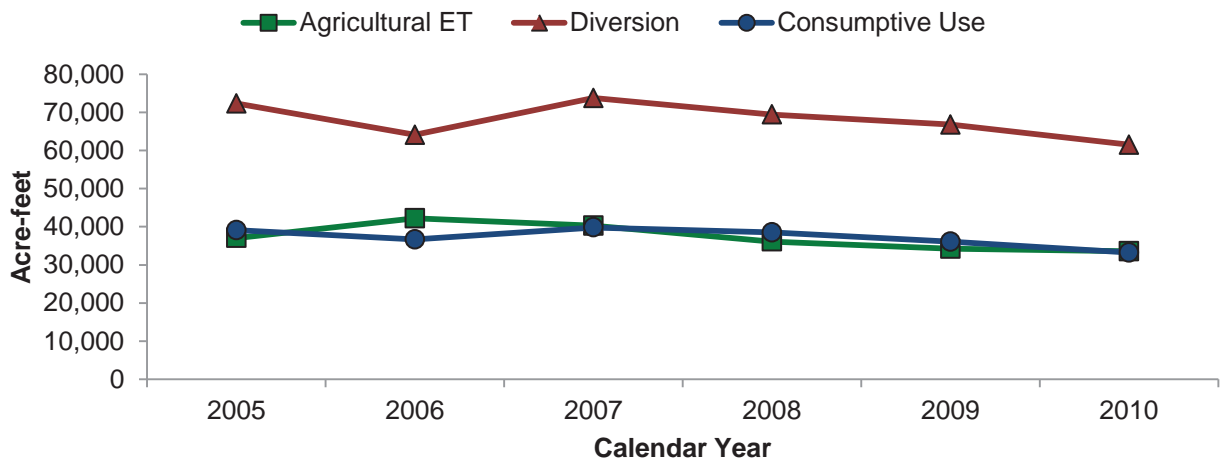
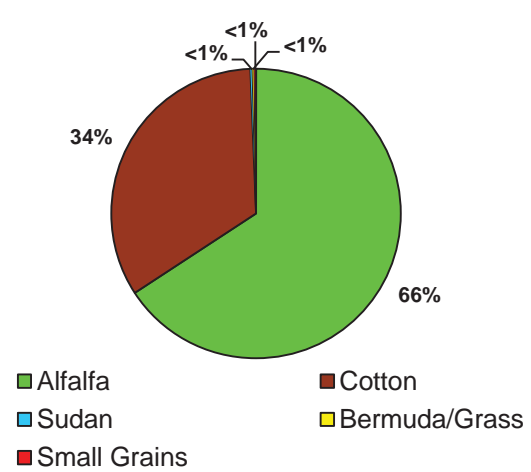
Open Water Acres:	34
Open Water Evaporation (acre-feet):	158



Major Crop Types



Annual Agricultural ET



Fort Mojave Indian Reservation - AZ

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	4,366	51	22,061	66
Bermuda/Grass	23	<1	72	<1
Cotton	4,158	48	11,267	34
Small Grains	35	<1	59	<1
Sudan	23	<1	78	<1
Total*	8,605	100%	33,539	100%

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

Gila Monster Farms - AZ

2010

River Reach: Imperial Dam to Mexico

Agriculture

Irrigable Acres:	1,704
Gross Cropped Acres:	3,040
Net Cropped Acres:	1,485
Fallowed/Idle Acres:	219
Agricultural Evapotranspiration (acre-feet):	4,479

Riparian

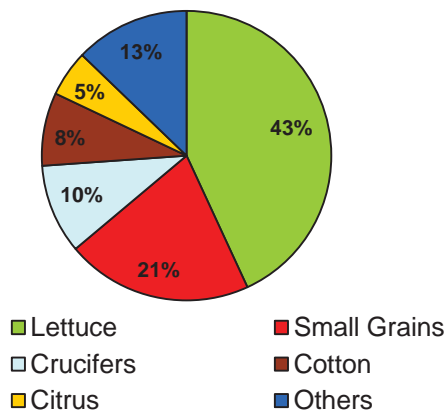
Riparian Vegetation Acres:	157
Riparian Evapotranspiration (acre-feet):	710

Open Water

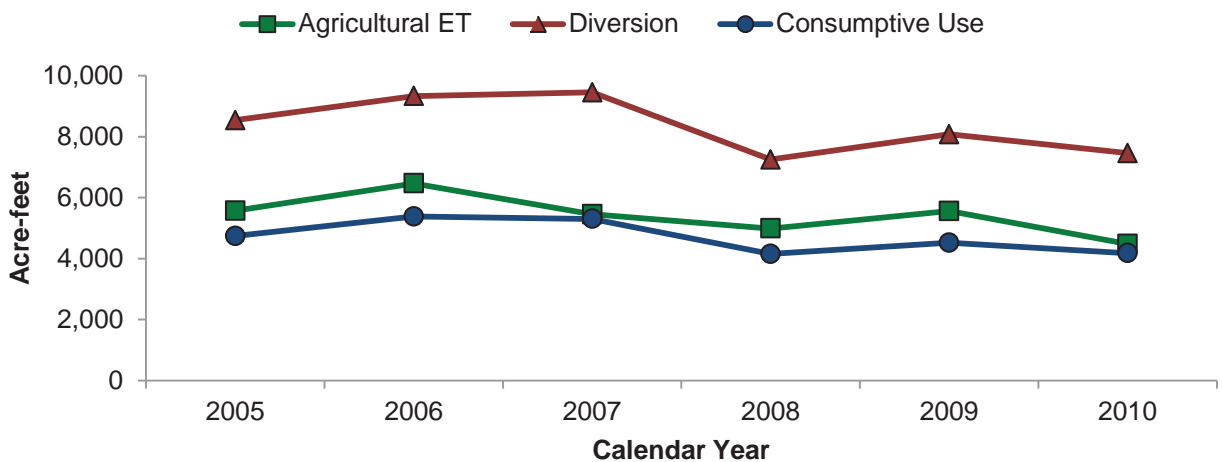
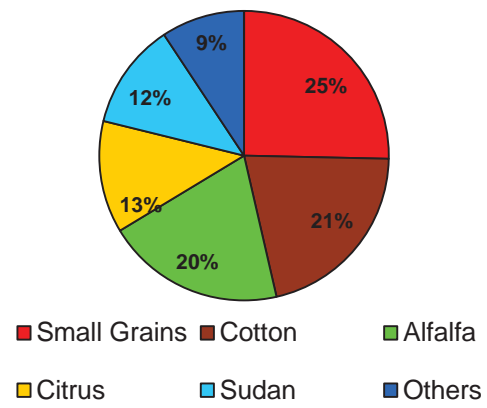
Open Water Acres:	19
Open Water Evaporation (acre-feet):	112



Major Crop Types



Annual Agricultural ET



Gila Monster Farms - AZ

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	154	5	813	18
Bermuda/Grass	31	1	105	2
Citrus	157	5	509	11
Cotton	248	8	859	19
Crucifers	304	10	156	3
Legume/Solanum Veg.	28	<1	71	2
Lettuce	1,310	43	379	8
Oil Crops	10	<1	27	<1
Small Grains	631	21	1,032	23
Small Vegetables	31	1	45	<1
Sudan	135	4	483	11
Total*	3,040	100%	4,479	100%

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

Havasu National Wildlife Refuge - AZ

2010

River Reach: Davis Dam to Parker Dam

Agriculture

Irrigable Acres:	144
Gross Cropped Acres:	144
Net Cropped Acres:	144
Fallowed/Idle Acres:	-
Agricultural Evapotranspiration (acre-feet):	321

Riparian

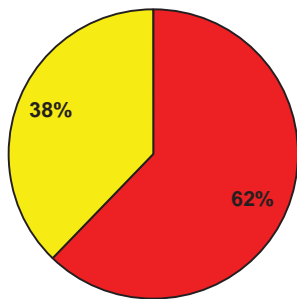
Riparian Vegetation Acres:	11,273
Riparian Evapotranspiration (acre-feet):	35,465

Open Water

Open Water Acres:	3,305
Open Water Evaporation (acre-feet):	15,320

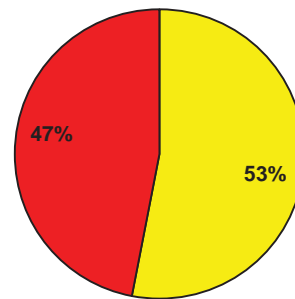


Major Crop Types

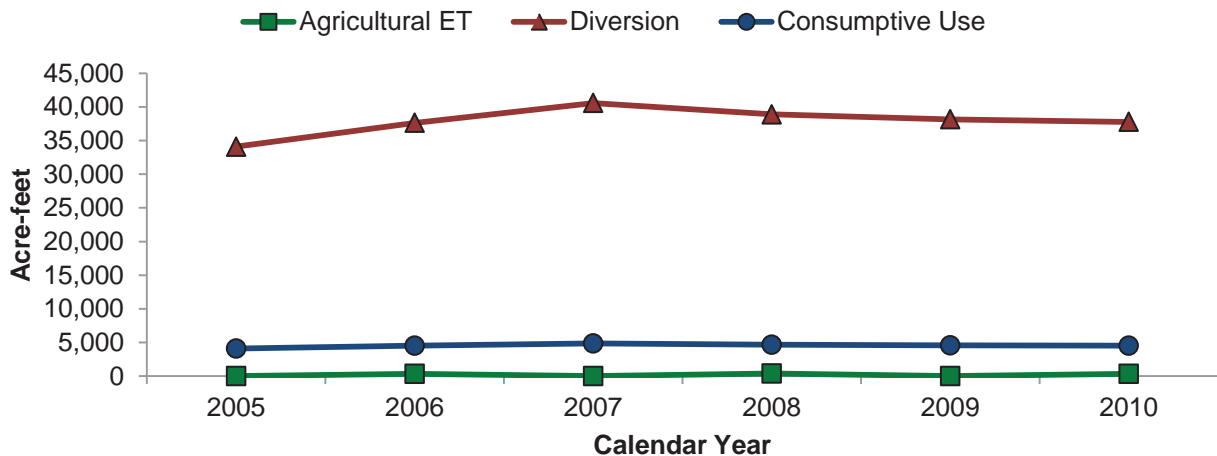


■ Small Grains ■ Bermuda/Grass

Annual Agricultural ET



■ Bermuda/Grass ■ Small Grains



Havasu National Wildlife Refuge - AZ

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Bermuda/Grass	55	38	171	53
Small Grains	90	62	151	47
Total	144	100%	321	100%

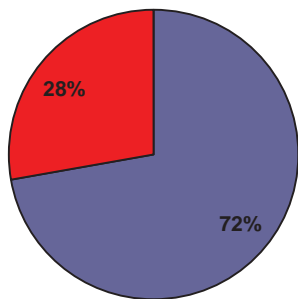
Imperial National Wildlife Refuge - AZ

2010

River Reach:	Parker Dam to Mexico
Agriculture	
Irrigable Acres:	38
Gross Cropped Acres:	38
Net Cropped Acres:	38
Fallowed/Idle Acres:	-
Agricultural Evapotranspiration (acre-feet):	145
Riparian	
Riparian Vegetation Acres:	9,481
Riparian Evapotranspiration (acre-feet):	28,439
Open Water	
Open Water Acres:	1,581
Open Water Evaporation (acre-feet):	8,483

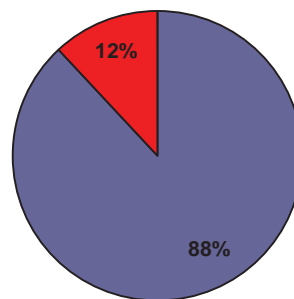


Major Crop Types

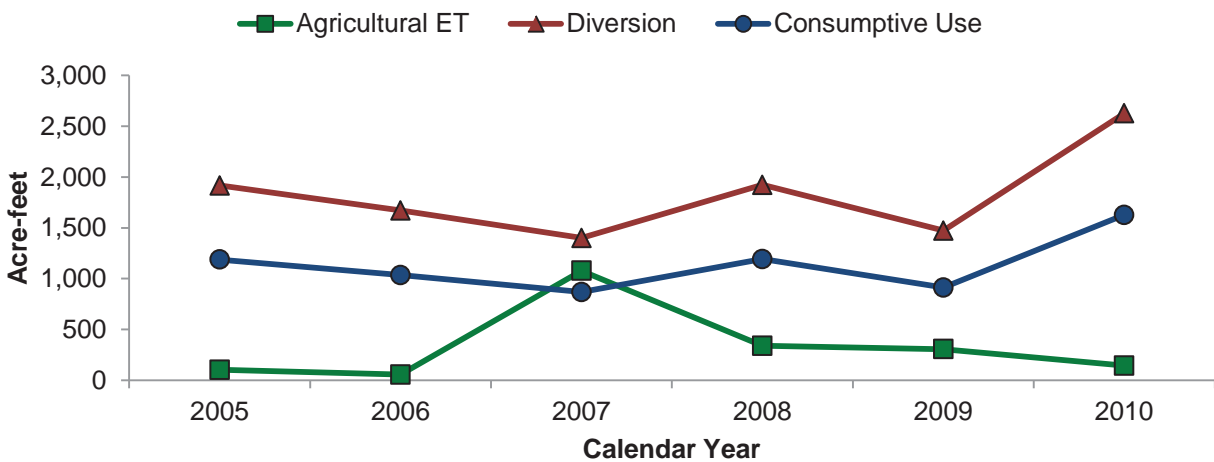


■ Deciduous Orchards ■ Small Grains

Annual Agricultural ET



■ Deciduous Orchards ■ Small Grains



Imperial National Wildlife Refuge - AZ

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Deciduous Orchards	28	72	128	88
Small Grains	11	28	17	12
Total*	38	100%	145	100%

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

Mohave Valley Irrigation and Drainage District - AZ

2010

River Reach: Davis Dam to Parker Dam

Agriculture

Irrigable Acres:	5,144
Gross Cropped Acres:	4,602
Net Cropped Acres:	4,629
Fallowed/Idle Acres:	516
Agricultural Evapotranspiration (acre-feet):	21,434

Riparian

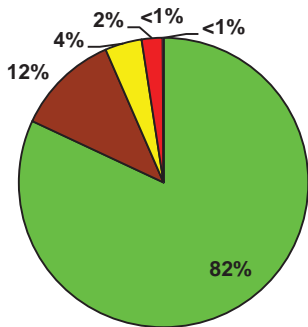
Riparian Vegetation Acres:	6,901
Riparian Evapotranspiration (acre-feet):	14,932

Open Water

Open Water Acres:	132
Open Water Evaporation (acre-feet):	611

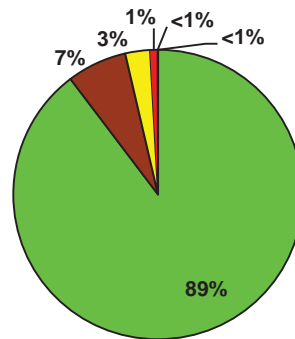


Major Crop Types

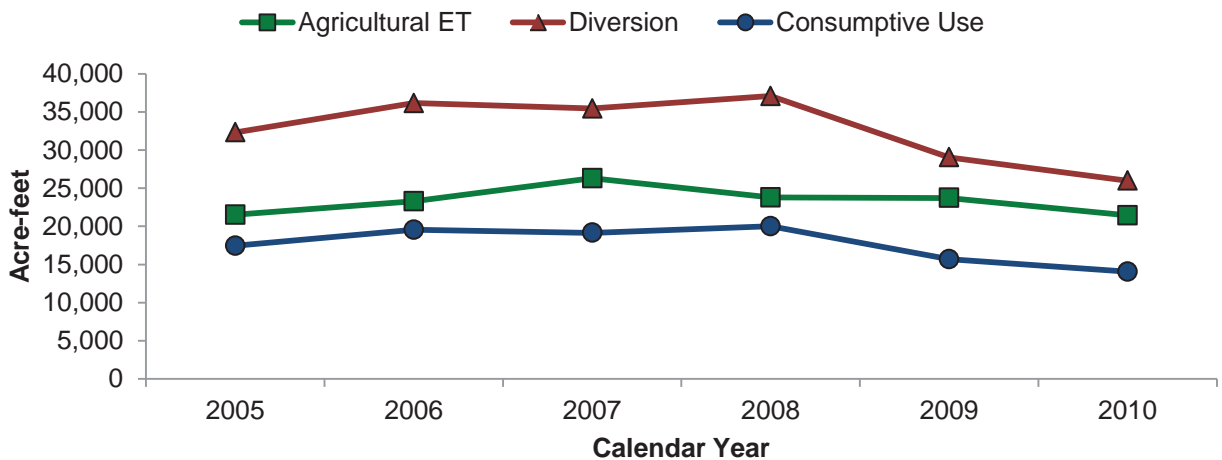


- Alfalfa
- Cotton
- Bermuda/Grass
- Small Grains
- Melons
- Others

Annual Agricultural ET



- Alfalfa
- Cotton
- Bermuda/Grass
- Small Grains
- Melons
- Others



Mohave Valley Irrigation and Drainage District - AZ 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	3,772	82	19,219	90
Bermuda/Grass	189	4	592	3
Cotton	529	11	1,434	7
Melons	5	<1	11	<1
Small Grains	106	2	178	<1
Total*	4,602	100%	21,434	100%

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

North Gila Valley Irrigation and Drainage District - AZ

2010

River Reach: Imperial Dam to Mexico

Agriculture

Irrigable Acres:	5,839
Gross Cropped Acres:	12,472
Net Cropped Acres:	5,720
Fallowed/Idle Acres:	119
Agricultural Evapotranspiration (acre-feet):	19,018

Riparian

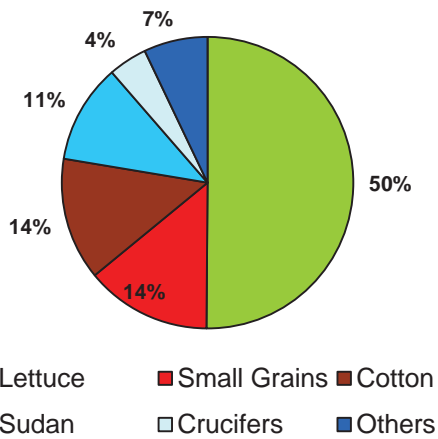
Riparian Vegetation Acres:	474
Riparian Evapotranspiration (acre-feet):	1,379

Open Water

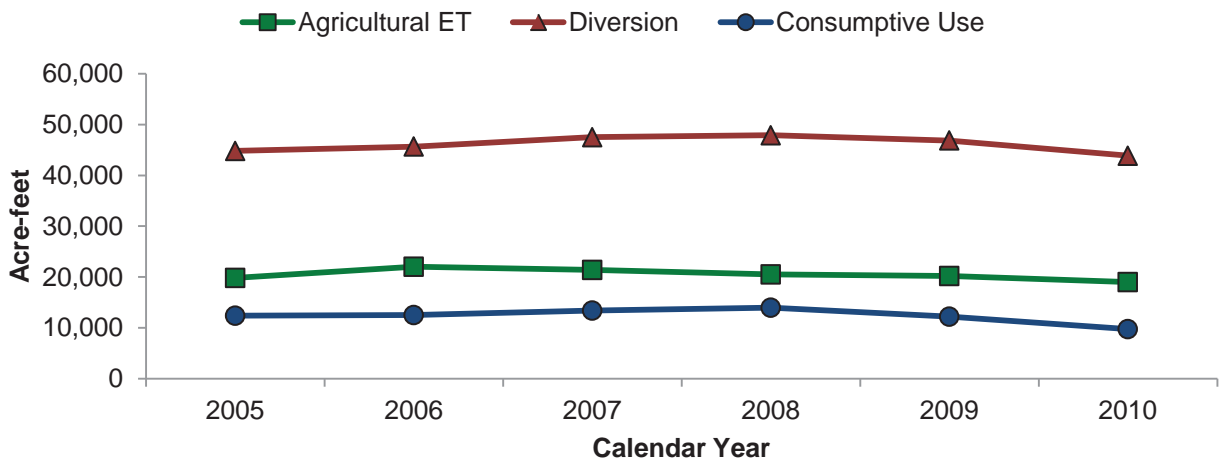
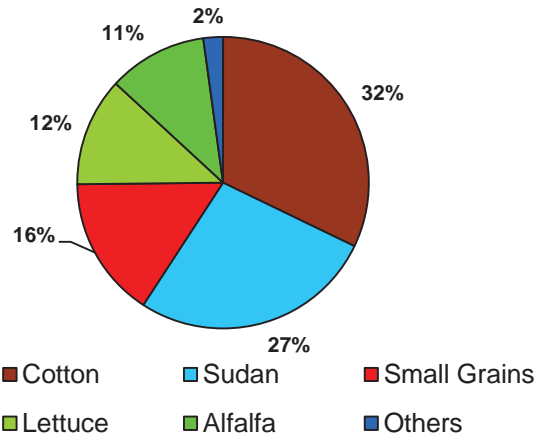
Open Water Acres:	8
Open Water Evaporation (acre-feet):	48



Major Crop Types



Annual Agricultural ET



North Gila Valley Irrigation and Drainage District - AZ 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	368	3	1,994	10
Bermuda/Grass	36	<1	131	<1
Citrus	13	<1	44	<1
Cotton	1,692	14	5,855	31
Crucifers	535	4	219	1
Dates	12	<1	72	<1
Field Grain	83	<1	191	1
Lettuce	6,251	50	2,192	12
Melons	230	2	396	2
Small Grains	1,740	14	2,846	15
Small Vegetables	140	1	158	<1
Sudan	1,372	11	4,921	26
Total*	12,472	100%	19,018	100%

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

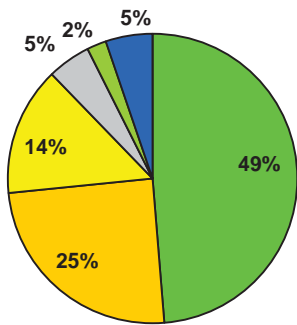
Unit B Irrigation and Drainage District - AZ

2010

River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	1,892
Gross Cropped Acres:	1,521
Net Cropped Acres:	1,593
Fallowed/Idle Acres:	299
Agricultural Evapotranspiration (acre-feet):	6,597
Riparian	
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-
Open Water	
Open Water Acres:	20
Open Water Evaporation (acre-feet):	120

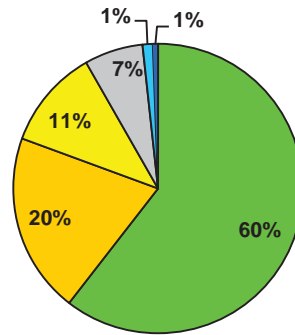


Major Crop Types

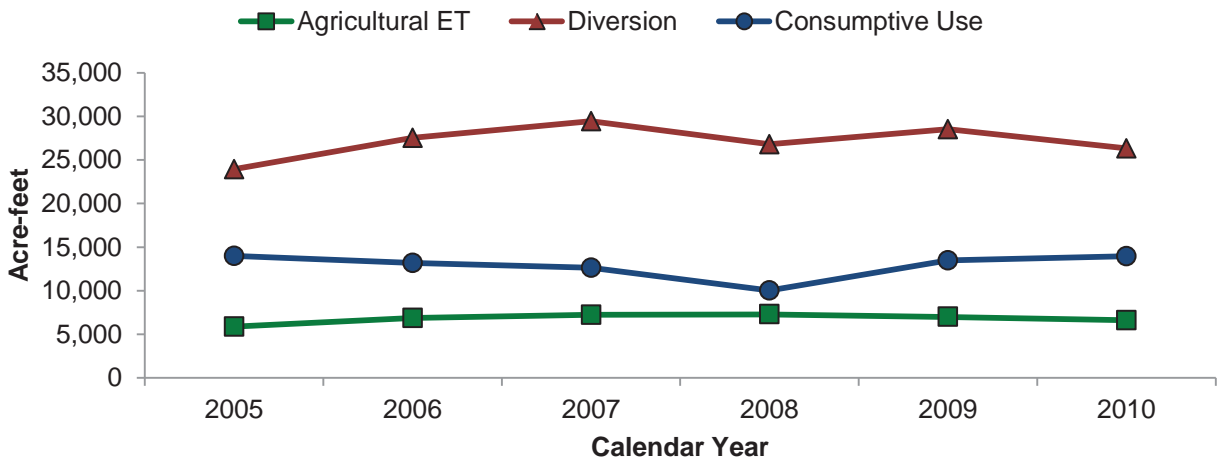


- Alfalfa
- Citrus
- Bermuda/Grass
- Dates
- Lettuce
- Others

Annual Agricultural ET



- Alfalfa
- Citrus
- Bermuda/Grass
- Sudan
- Others



Unit B Irrigation and Drainage District - AZ 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	741	49	3,942	60
Bermuda/Grass	218	14	725	11
Citrus	376	25	1,308	20
Crucifers	16	1	10	<1
Dates	74	5	426	6
Deciduous Orchards	6	<1	25	<1
Lettuce	33	2	17	<1
Nursery/Greenhouse	18	1	38	<1
Small Grains	20	1	32	<1
Sudan	21	1	74	1
Total*	1,521	100%	6,597	100%

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

Wellton-Mohawk Irrigation and Drainage District - AZ

2010

River Reach: Imperial Dam to Mexico

Agriculture

Irrigable Acres:	58,283
Gross Cropped Acres:	83,526
Net Cropped Acres:	56,030
Fallowed/Idle Acres:	2,253
Agricultural Evapotranspiration (acre-feet):	187,633

Riparian

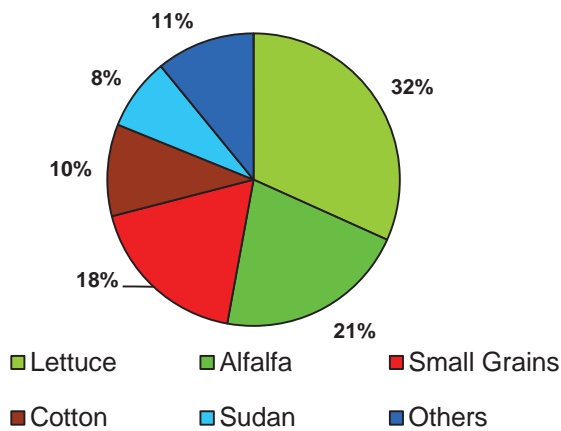
Riparian Vegetation Acres:	2
Riparian Evapotranspiration (acre-feet):	2

Open Water

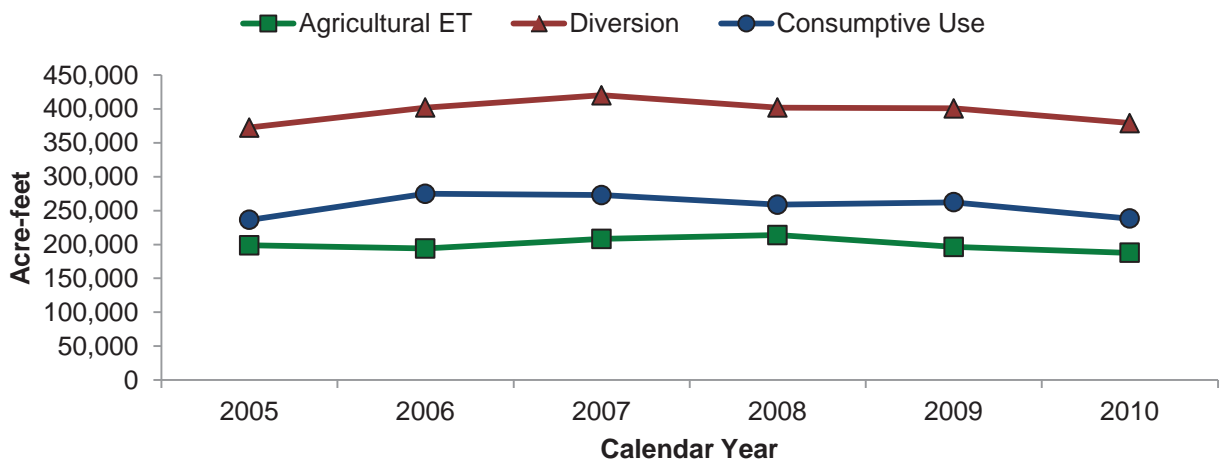
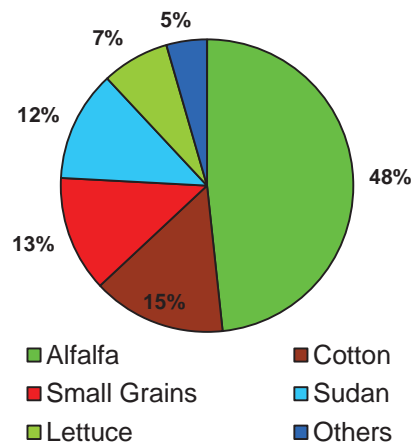
Open Water Acres:	133
Open Water Evaporation (acre-feet):	722



Major Crop Types



Annual Agricultural ET



Wellton-Mohawk Irrigation and Drainage District - AZ 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	17,660	21	86,389	46
Bermuda/Grass	2,603	3	8,018	4
Citrus	376	<1	1,120	<1
Cotton	8,467	10	26,394	14
Crucifers	2,048	2	881	<1
Dates	7	<1	35	<1
Deciduous Orchards	8	<1	5	<1
Field Grain	1,614	2	3,556	2
Legume/Solanum Veg.	293	<1	627	<1
Lettuce	26,504	32	13,361	7
Melons	1,307	2	1,649	<1
Small Grains	15,126	18	22,902	12
Small Vegetables	686	<1	780	<1
Sudan	6,653	8	21,829	12
Sugar Beets	173	<1	87	<1
Total*	83,526	100%	187,633	100%

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

Yuma County Water Users' Association - AZ

2010

River Reach: Imperial Dam to Mexico

Agriculture

Irrigable Acres:	41,274
Gross Cropped Acres:	87,917
Net Cropped Acres:	40,734
Fallowed/Idle Acres:	541
Agricultural Evapotranspiration (acre-feet):	110,842

Riparian

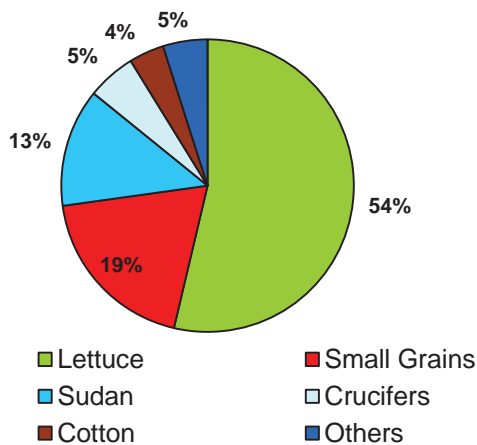
Riparian Vegetation Acres:	3
Riparian Evapotranspiration (acre-feet):	5

Open Water

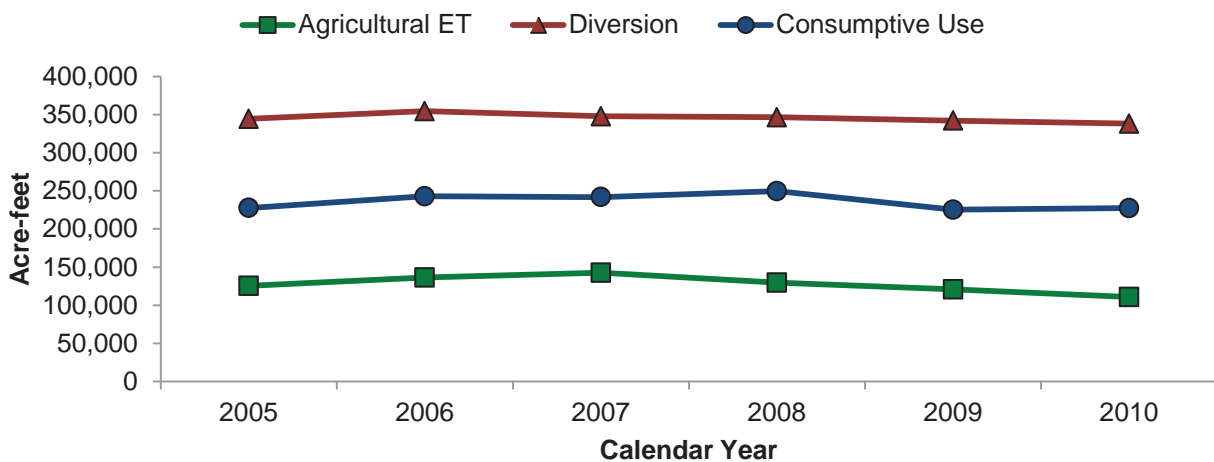
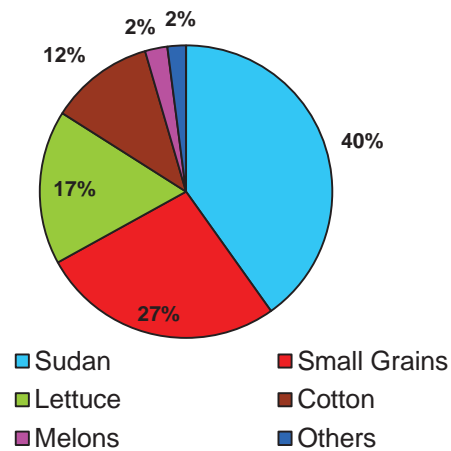
Open Water Acres:	312
Open Water Evaporation (acre-feet):	1,869



Major Crop Types



Annual Agricultural ET



Yuma County Water Users' Association - AZ 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	171	<1	892	<1
Bermuda/Grass	349	<1	1,278	1
Citrus	288	<1	988	<1
Cotton	3,402	4	11,776	11
Crucifers	4,724	5	2,092	2
Dates	264	<1	1,505	1
Deciduous Orchards	119	<1	534	<1
Field Grain	8	<1	19	<1
Grapes	1	<1	2	<1
Legume/Solanum Veg.	662	<1	1,668	2
Lettuce	47,210	54	17,436	16
Melons	1,529	2	2,528	2
Miscellaneous herbs	76	<1	219	<1
Nursery/Greenhouse	280	<1	608	<1
Oil Crops	11	<1	30	<1
Perennial Vegetables	2	<1	1	<1
Small Grains	16,790	19	27,463	25
Small Vegetables	567	<1	682	<1
Sudan	11,463	13	41,122	37
Total*	87,917	100%	110,842	100%

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

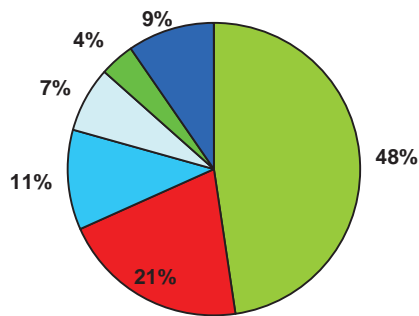
Yuma Irrigation District - AZ

2010

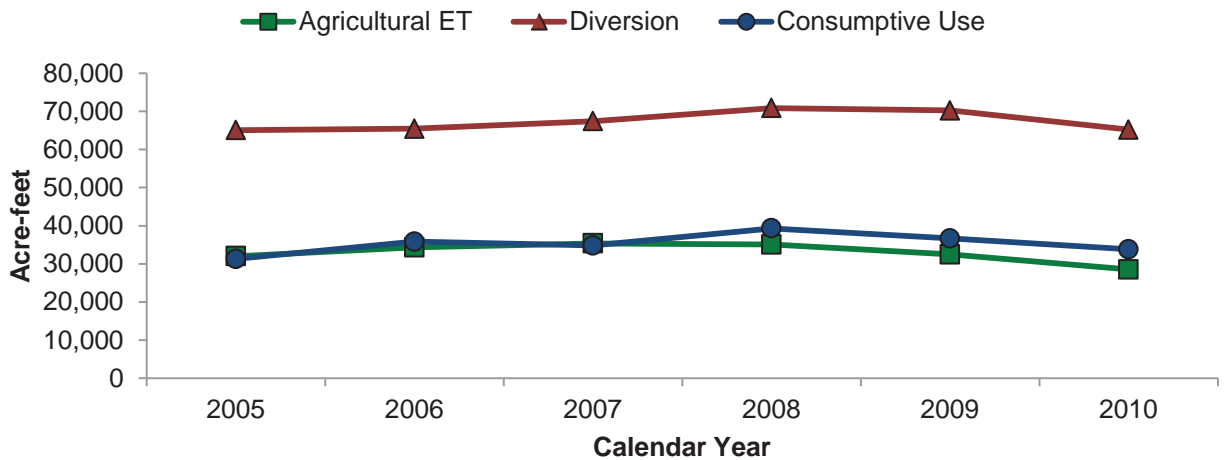
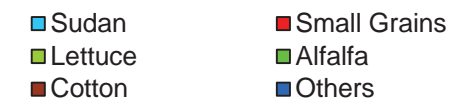
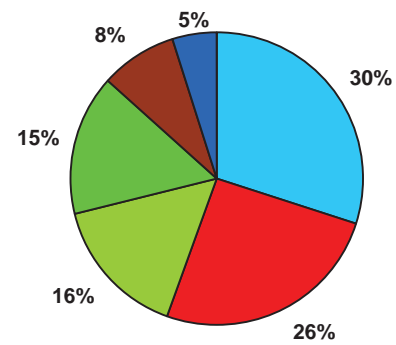
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	9,989
Gross Cropped Acres:	20,079
Net Cropped Acres:	9,917
Fallowed/Idle Acres:	73
Agricultural Evapotranspiration (acre-feet):	28,520
Riparian	
Riparian Vegetation Acres:	266
Riparian Evapotranspiration (acre-feet):	463
Open Water	
Open Water Acres:	61
Open Water Evaporation (acre-feet):	366



Major Crop Types



Annual Agricultural ET



Yuma Irrigation District - AZ

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	768	4	4,120	14
Bermuda/Grass	17	<1	55	<1
Citrus	10	<1	39	<1
Cotton	649	3	2,245	8
Crucifers	1,449	7	642	2
Dates	21	<1	119	<1
Field Grain	54	<1	123	<1
Legume/Solanum Veg.	512	3	1,300	5
Lettuce	9,568	48	4,146	15
Melons	420	2	705	2
Nursery/Greenhouse	28	<1	62	<1
Small Grains	4,145	21	6,780	24
Small Vegetables	220	1	225	<1
Sudan	2,219	11	7,960	28
Total*	20,079	100%	28,520	100%

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

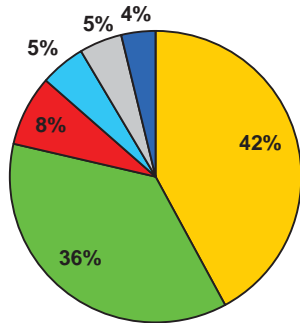
Yuma Mesa Irrigation and Drainage District - AZ

2010

River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	16,532
Gross Cropped Acres:	15,615
Net Cropped Acres:	15,180
Fallowed/Idle Acres:	1,352
Agricultural Evapotranspiration (acre-feet):	62,573
Riparian	
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-
Open Water	
Open Water Acres:	172
Open Water Evaporation (acre-feet):	1,030

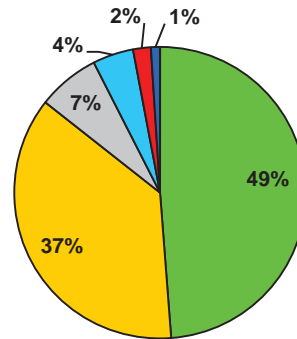


Major Crop Types

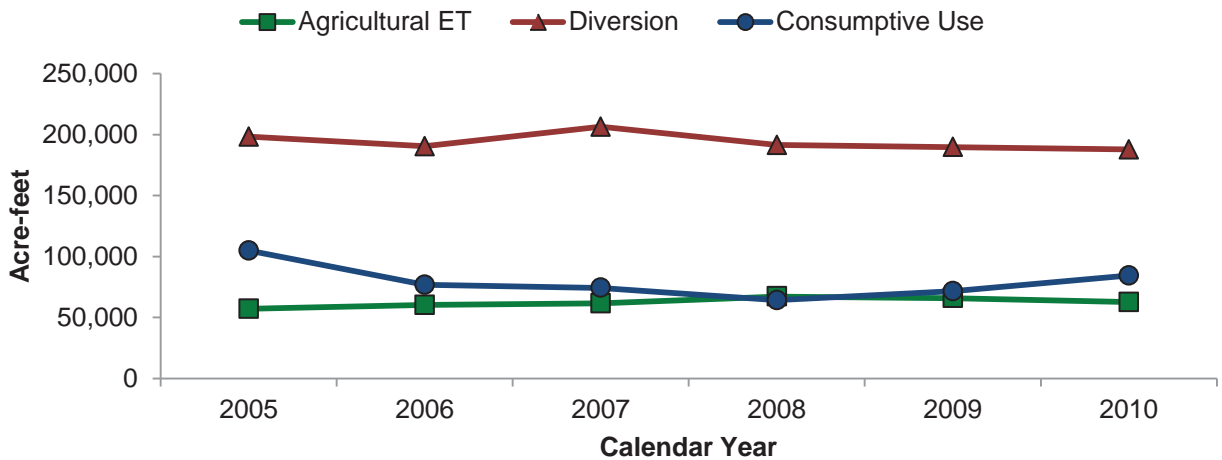


- Citrus
- Alfalfa
- Small Grains
- Sudan
- Dates
- Others

Annual Agricultural ET



- Alfalfa
- Citrus
- Dates
- Sudan
- Small Grains
- Others



Yuma Mesa Irrigation and Drainage District - AZ 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	5,704	37	30,298	48
Bermuda/Grass	190	1	629	1
Citrus	6,573	42	22,869	37
Crucifers	89	<1	47	<1
Dates	739	5	4,276	7
Deciduous Orchards	1	<1	3	<1
Lettuce	157	1	83	<1
Miscellaneous herbs	48	<1	139	<1
Nursery/Greenhouse	85	<1	182	<1
Small Grains	1,224	8	1,216	2
Small Vegetables	22	<1	19	<1
Sudan	784	5	2,812	4
Total*	15,615	100%	62,573	100%

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

Chemehuevi Indian Reservation - CA

2010

River Reach: Davis Dam to Parker Dam

Agriculture

Irrigable Acres:	58
Gross Cropped Acres:	-
Net Cropped Acres:	-
Fallowed/Idle Acres:	58
Agricultural Evapotranspiration (acre-feet):	-

Riparian

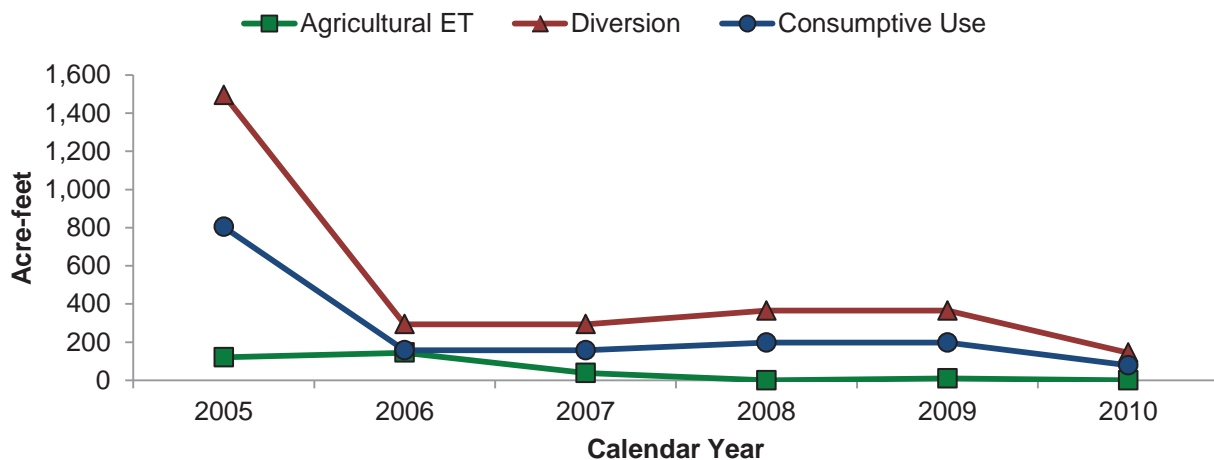
Riparian Vegetation Acres:	23
Riparian Evapotranspiration (acre-feet):	29

Open Water

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



No agricultural crops grown in 2010.



Chemehuevi Indian Reservation - CA

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
No agricultural crops grown in 2010.				

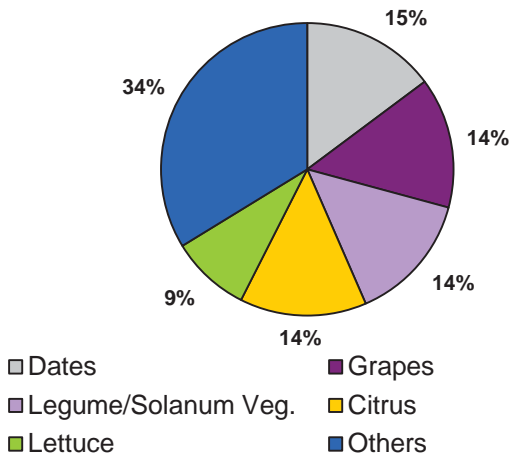
Coachella Valley Water District - CA

2010

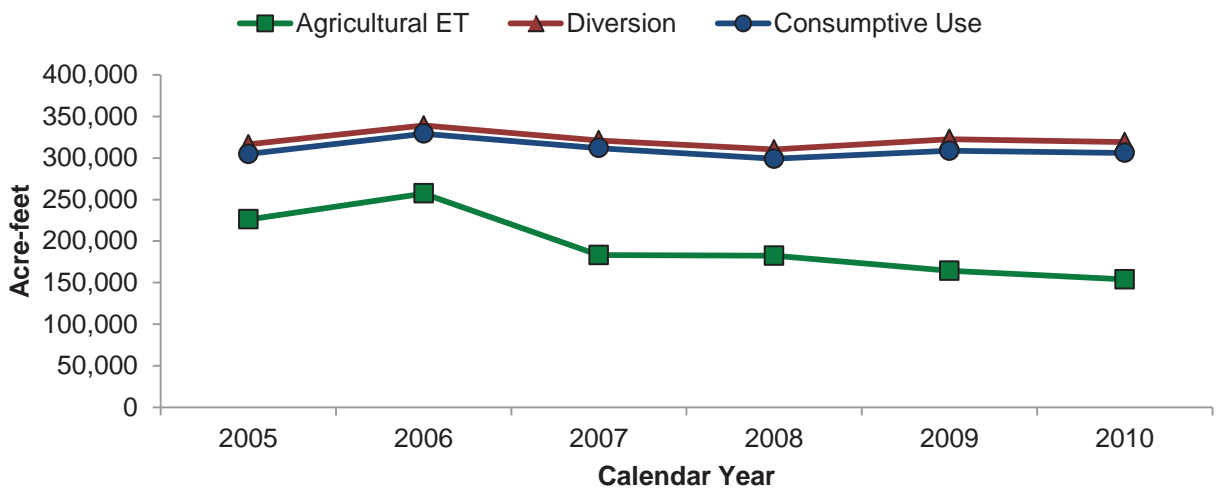
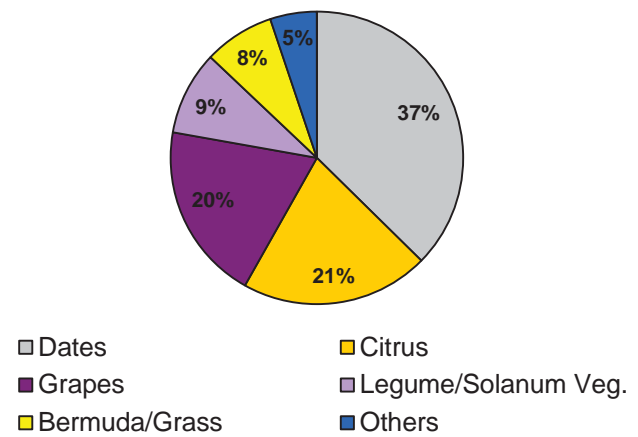
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	57,124
Gross Cropped Acres:	56,404
Net Cropped Acres:	48,527
Fallowed/Idle Acres:	8,598
Agricultural Evapotranspiration (acre-feet):	153,872
Riparian	
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-
Open Water	
Open Water Acres:	886
Open Water Evaporation (acre-feet):	5,521



Major Crop Types



Annual Agricultural ET



Coachella Valley Water District - CA

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	388	<1	2,000	1
Bermuda/Grass	2,215	4	9,822	6
Citrus	7,905	14	26,257	17
Crucifers	3,290	6	3,127	2
Dates	8,345	15	47,186	31
Deciduous Orchards	366	<1	1,652	1
Field Grain	2,258	4	6,513	4
Grapes	8,130	14	24,790	16
Legume/Solanum Veg.	8,034	14	11,702	8
Lettuce	4,948	9	3,694	2
Melons	1,831	3	3,075	2
Miscellaneous herbs	1,276	2	2,790	2
Moist Soil Unit	87	<1	433	<1
Nursery/Greenhouse	1,492	3	3,168	2
Perennial Vegetables	504	<1	455	<1
Root Vegetables	332	<1	227	<1
Small Grains	91	<1	176	<1
Small Vegetables	4,163	7	4,653	3
Sudan	576	1	1,773	1
Tomatoes	174	<1	380	<1
Total*	56,404	100%	153,872	100%

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

Fort Mojave Indian Reservation - CA

2010

River Reach: Davis Dam to Parker Dam

Agriculture

Irrigable Acres:	3,216
Gross Cropped Acres:	3,731
Net Cropped Acres:	3,164
Fallowed/Idle Acres:	53
Agricultural Evapotranspiration (acre-feet):	10,277

Riparian

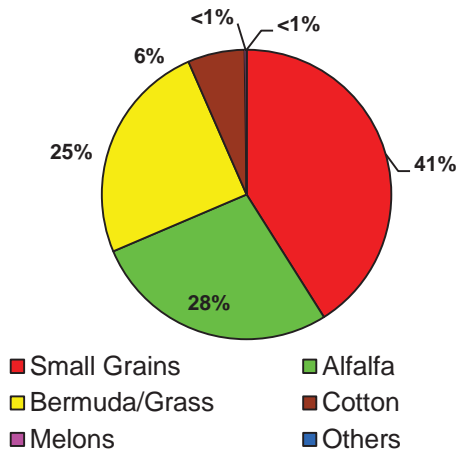
Riparian Vegetation Acres:	1,025
Riparian Evapotranspiration (acre-feet):	3,079

Open Water

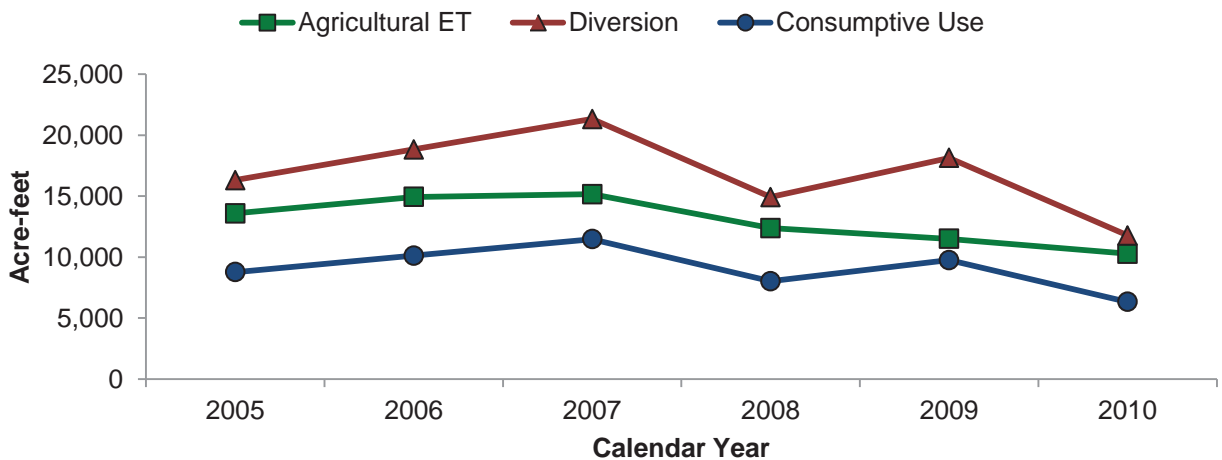
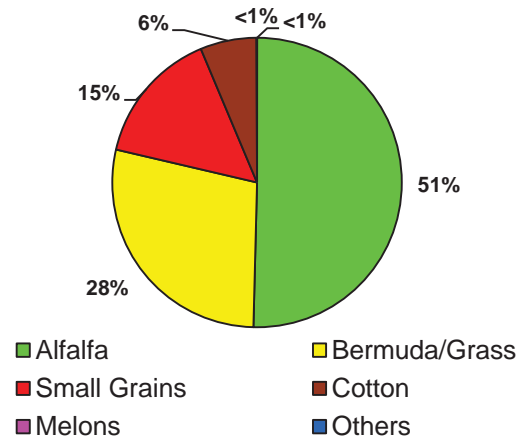
Open Water Acres:	-
Open Water Evaporation (acre-feet):	-



Major Crop Types



Annual Agricultural ET



Fort Mojave Indian Reservation - CA

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	1,028	28	5,179	50
Bermuda/Grass	928	25	2,904	28
Cotton	237	6	642	6
Melons	8	<1	10	<1
Small Grains	1,531	41	1,543	15
Total*	3,731	100%	10,277	100%

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

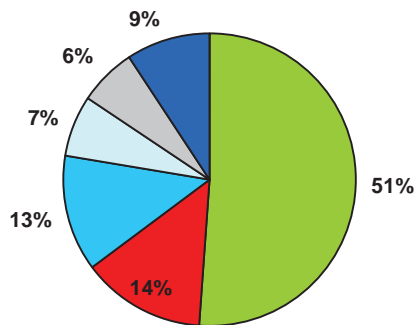
Yuma Project Reservation Division, Bard Unit - CA

2010

River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	6,380
Gross Cropped Acres:	12,939
Net Cropped Acres:	6,340
Fallowed/Idle Acres:	40
Agricultural Evapotranspiration (acre-feet):	19,359
Riparian	
Riparian Vegetation Acres:	176
Riparian Evapotranspiration (acre-feet):	558
Open Water	
Open Water Acres:	28
Open Water Evaporation (acre-feet):	170

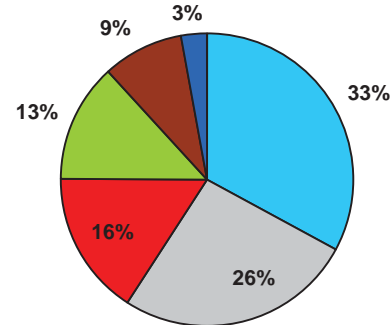


Major Crop Types

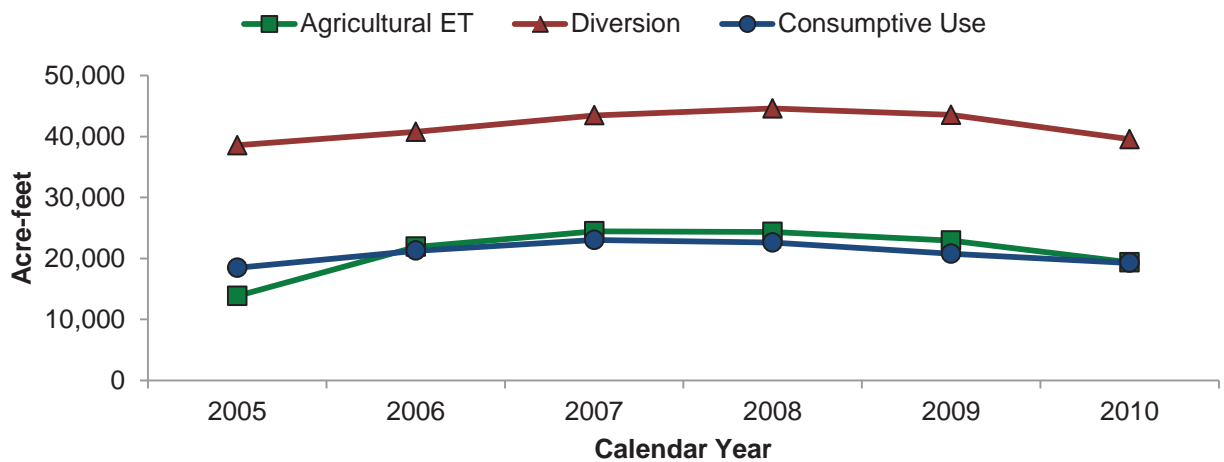


■ Lettuce ■ Small Grains ■ Sudan
■ Crucifers ■ Dates ■ Others

Annual Agricultural ET



■ Sudan ■ Dates ■ Small Grains
■ Lettuce ■ Cotton ■ Others



Yuma Project Reservation Division, Bard Unit - CA 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	46	<1	216	1
Bermuda/Grass	6	<1	22	<1
Citrus	115	<1	396	2
Cotton	468	4	1,620	8
Crucifers	875	7	341	2
Dates	822	6	4,753	25
Deciduous Orchards	7	<1	31	<1
Legume/Solanum Veg.	35	<1	90	<1
Lettuce	6,617	51	2,374	12
Melons	300	2	518	3
Small Grains	1,766	14	2,888	15
Small Vegetables	221	2	152	<1
Sudan	1,662	13	5,961	31
Total*	12,939	100%	19,359	100%

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

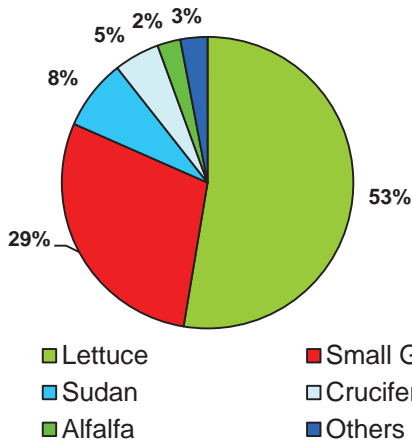
Yuma Project Reservation Division Indian Unit - CA

2010

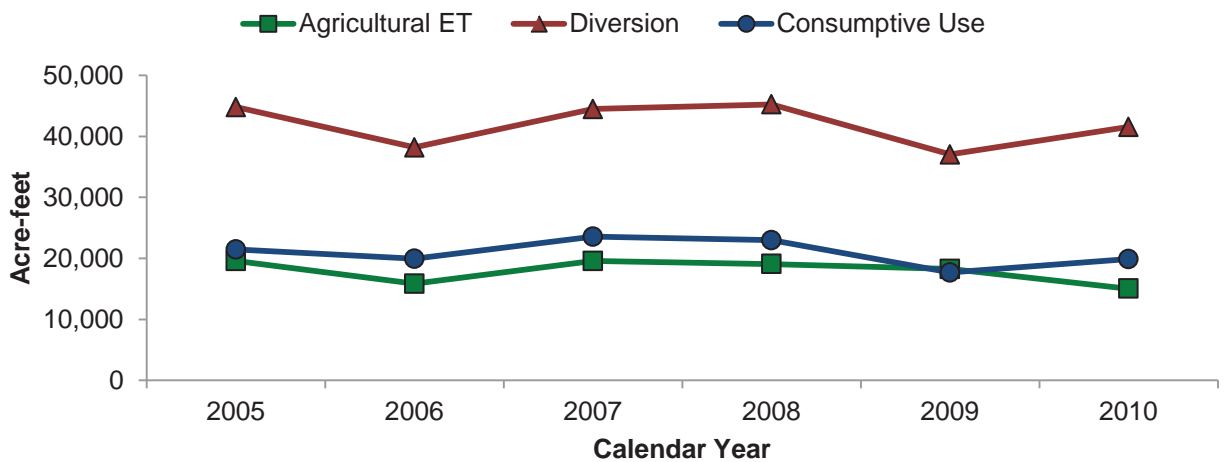
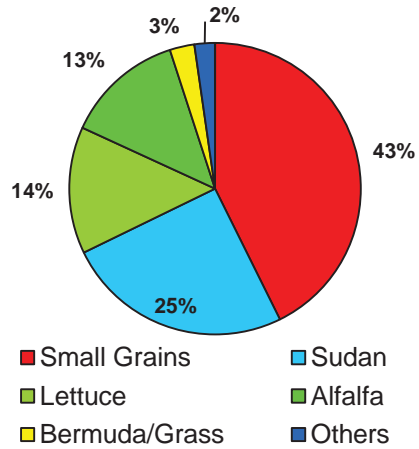
River Reach:	Imperial Dam to Mexico
Agriculture	
Irrigable Acres:	6,145
Gross Cropped Acres:	12,972
Net Cropped Acres:	5,974
Fallowed/Idle Acres:	171
Agricultural Evapotranspiration (acre-feet):	15,034
Riparian	
Riparian Vegetation Acres:	305
Riparian Evapotranspiration (acre-feet):	882
Open Water	
Open Water Acres:	20
Open Water Evaporation (acre-feet):	120



Major Crop Types



Annual Agricultural ET



Yuma Project Reservation Division Indian Unit - CA 2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	334	3	1,895	13
Bermuda/Grass	120	<1	393	3
Cotton	49	<1	171	1
Crucifers	655	5	264	2
Dates	9	<1	54	<1
Legume/Solanum Veg.	129	<1	327	2
Lettuce	6,827	53	2,024	13
Melons	49	<1	85	<1
Miscellaneous herbs	15	<1	43	<1
Small Grains	3,758	29	6,147	41
Small Vegetables	17	<1	8	<1
Sudan	1,010	8	3,622	24
Total*	12,972	100%	15,034	100%

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

Imperial Irrigation District - CA

2010

River Reach: Imperial Dam to Mexico

Agriculture

Irrigable Acres:	430,627
Gross Cropped Acres:	488,917
Net Cropped Acres:	399,352
Fallowed/Idle Acres:	31,275
Agricultural Evapotranspiration (acre-feet):	1,448,441

Riparian

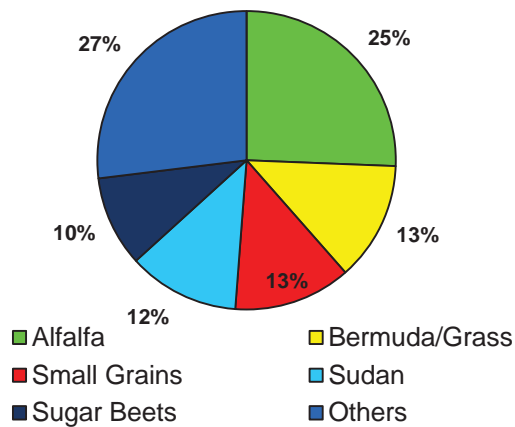
Riparian Vegetation Acres:	-
Riparian Evapotranspiration (acre-feet):	-

Open Water

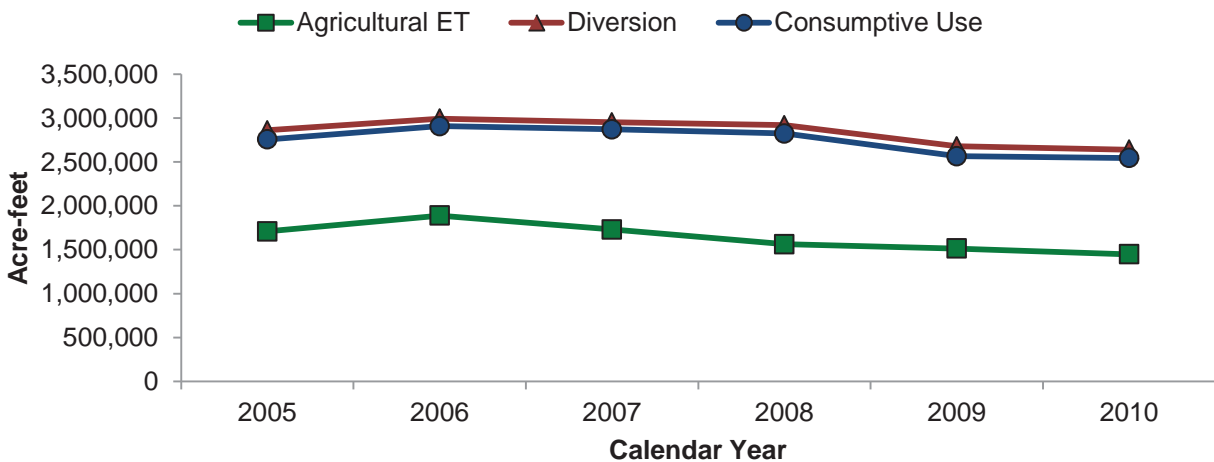
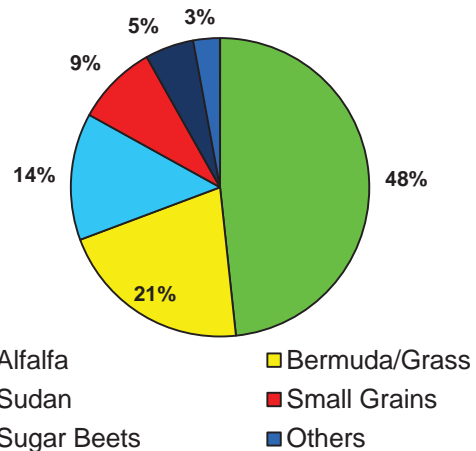
Open Water Acres:	1,692
Open Water Evaporation (acre-feet):	10,457



Major Crop Types



Annual Agricultural ET



Imperial Irrigation District - CA

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	125,287	26	636,539	44
Aloe	73	<1	154	<1
Bermuda/Grass	63,016	13	276,629	19
Cane/Bamboo	391	<1	2,251	<1
Citrus	6,318	1	20,155	1
Cotton	395	<1	1,275	<1
Crucifers	26,743	5	19,441	1
Dates	795	<1	4,494	<1
Deciduous Orchards	375	<1	1,692	<1
Field Grain	9,616	2	27,737	2
Legume/Solanum Veg.	1,311	<1	1,372	<1
Lettuce	44,952	9	30,915	2
Melons	5,603	1	9,644	<1
Miscellaneous herbs	27	<1	60	<1
Moist Soil Unit	1,685	<1	8,400	<1
Nursery/Greenhouse	628	<1	1,332	<1
Oil Crops	22	<1	52	<1
Perennial Vegetables	104	<1	392	<1
Small Grains	62,082	13	115,979	8
Small Vegetables	32,174	7	38,104	3
Sudan	58,946	12	181,358	13
Sugar Beets	47,864	10	69,434	5
Tomatoes	7	<1	15	<1
Wildlife Forage Maintained	502	<1	1,017	<1
Total*	488,917	100%	1,448,441	100%

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

Palo Verde Irrigation District - CA

2010

River Reach: Parker Dam to Imperial Dam

Agriculture

Irrigable Acres:	89,802
Gross Cropped Acres:	55,459
Net Cropped Acres:	62,961
Fallowed/Idle Acres:	26,841
Agricultural Evapotranspiration (acre-feet):	231,342

Riparian

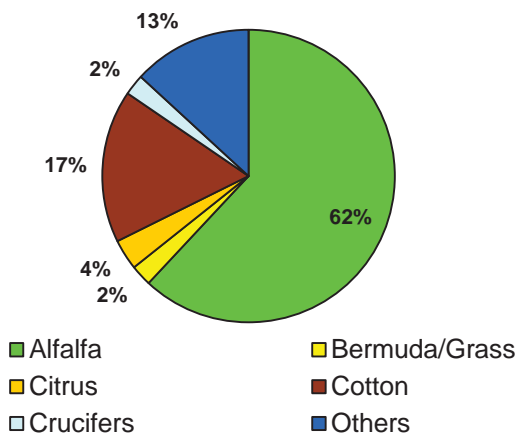
Riparian Vegetation Acres:	2,460
Riparian Evapotranspiration (acre-feet):	5,192

Open Water

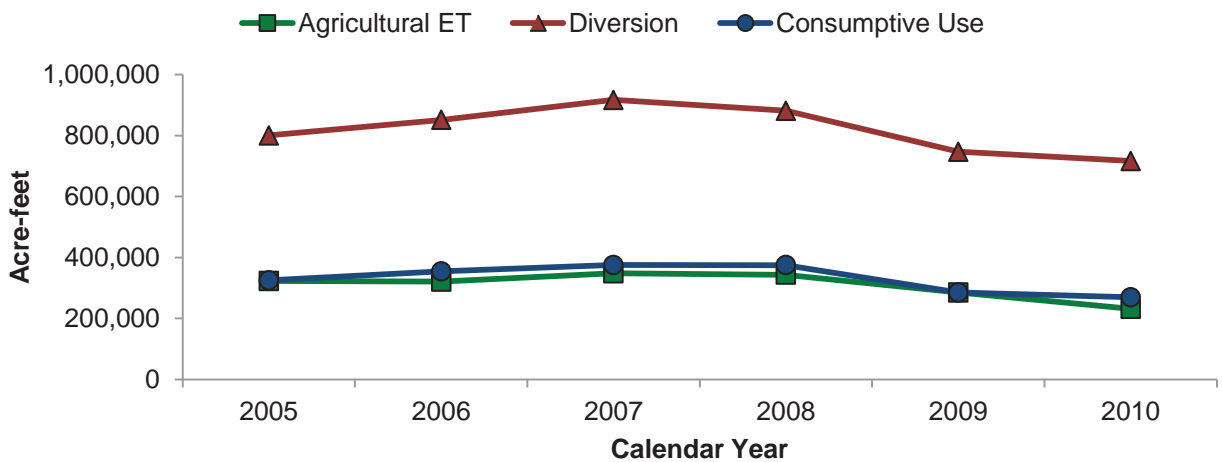
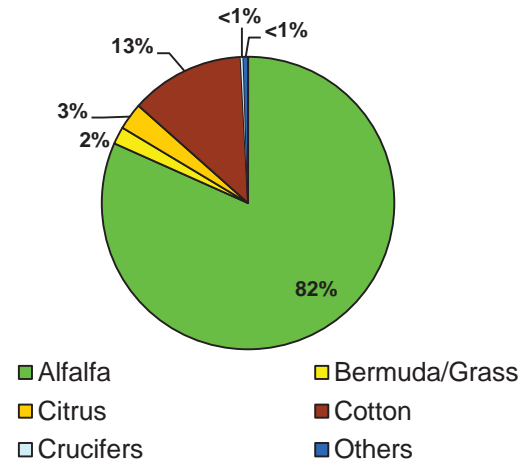
Open Water Acres:	195
Open Water Evaporation (acre-feet):	1,008



Major Crop Types



Annual Agricultural ET



Palo Verde Irrigation District - CA

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Alfalfa	34,362	62	173,597	75
Bermuda/Grass	1,296	2	4,088	2
Citrus	1,868	3	6,271	3
Cotton	9,357	17	26,875	12
Crucifers	1,279	2	641	<1
Dates	193	<1	1,072	<1
Deciduous Orchards	488	<1	2,230	<1
Field Grain	189	<1	444	<1
Grapes	35	<1	104	<1
Lettuce	417	<1	226	<1
Melons	2,085	4	3,719	2
Moist Soil Unit	41	<1	200	<1
Nursery/Greenhouse	9	<1	18	<1
Small Grains	685	1	1,131	<1
Sudan	3,156	6	10,727	5
Total*	55,459	100%	231,342	100%

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

Fort Mojave Indian Reservation - NV

2010

River Reach: Davis Dam to Parker Dam

Agriculture

Irrigable Acres:	412
Gross Cropped Acres:	406
Net Cropped Acres:	406
Fallowed/Idle Acres:	6
Agricultural Evapotranspiration (acre-feet):	1,101

Riparian

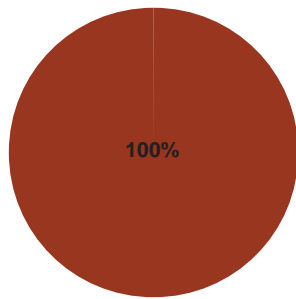
Riparian Vegetation Acres:	2,532
Riparian Evapotranspiration (acre-feet):	3,856

Open Water

Open Water Acres:	12
Open Water Evaporation (acre-feet):	55

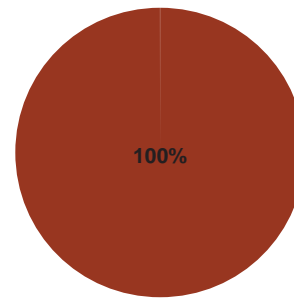


Major Crop Types

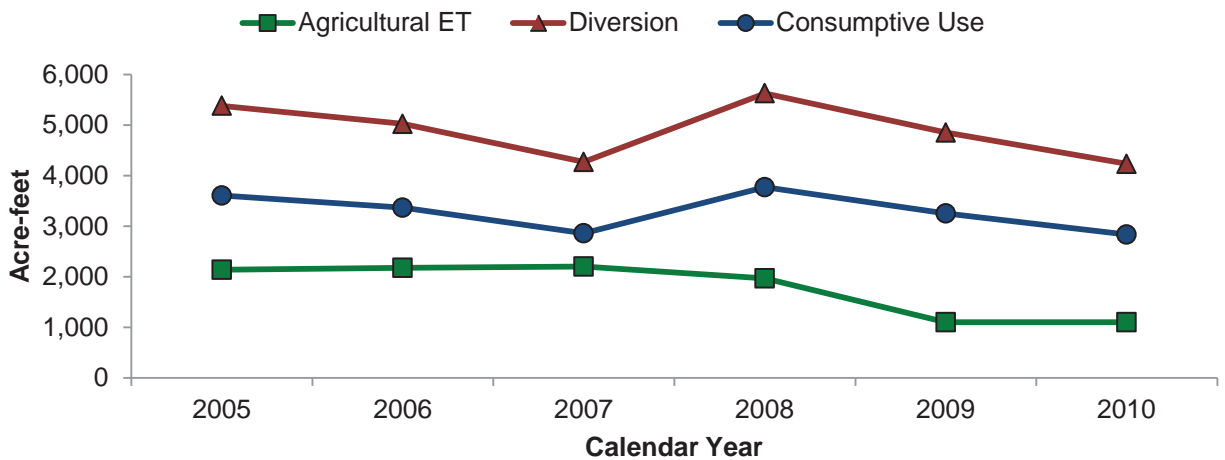


■ Cotton

Annual Agricultural ET



■ Cotton



Fort Mojave Indian Reservation - NV

2010

Crop Type	Acres	Acres % Total	Annual ET (acre-feet)	Annual ET % Total
Cotton	406	100	1,101	100
Total	406	100%	1,101	100%

**Other Water Users Not Reported on Individual Fact Sheets
2010**

Water User	River Reach	Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
		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	353	357	353	-	Alfalfa Cotton	196 161	1,006 462				
						Total	357	1,468	718	1,568	-	-
State of Arizona, Alamo Dam to Bill Williams River National Wildlife Refuge*	Davis Dam to Parker Dam	410	369	369	40	Sudan	369	1,252				
						Total	369	1,252	8,482	16,215	65	301
Bill Williams River National Wildlife Refuge	Davis Dam to Parker Dam	-	-	-	-							
						Total	-	-	2,459	7,646	-	-
Ehrenberg Farm - AZ	Parker Dam to Imperial Dam	679	687	679	-	Alfalfa Sudan	538 149	2,770 507				
						Total	687	3,277	-	-	-	-
Fort Yuma Indian Reservation and Homesteads	Imperial Dam to Mexico	533	677	336	197	Alfalfa Bermuda/Grass Crucifers Lettuce Small Grains Sudan	18 14 103 290 197 54	16 46 31 127 322 193				
						Total	677	735	1,173	2,168	4	22
Fort Yuma Indian Reservation, Mittry Lake State Wildlife Area and Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-							
						Total	-	-	213	774	30	179
Havasu State Park (Windsor Beach)	Davis Dam to Parker Dam	-	-	-	-							
						Total	-	-	1,177	2,290	-	-
Hillander "C" Irrigation District*	Imperial Dam to Mexico	2,540	1,256	1,392	1,148	Alfalfa Citrus Sudan	282 847 127	1,516 2,970 454				
						Total	1,256	4,941	-	-	-	-
Lake Mead National Recreation Area (Hoover Dam to Davis Dam)	Hoover Dam to Davis Dam	-	-	-	-							
						Total	-	-	263	345	7	32
Lake Mead National Recreation Area (Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-							
						Total	-	-	124	224	63	292
Mittry Lake State Wildlife Area	Imperial Dam to Mexico	37	57	37	-	Lettuce Melons Small Grains Small Vegetables Sudan	15 2 23 5 13	10 3 37 2 46				
						Total	57	99	2,253	6,850	82	489

*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
2010**

Water User	River Reach	Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
		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	148	148	148	-	Cotton	148	425				
						Total	148	425	125	352	46	237
State of Arizona (Other users, Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-		-	-				
						Total	-	-	1,433	2,466	-	-
State of Arizona (Other users, Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	-	-	6,184	14,154	116	600
State of Arizona (Other Users, Imperial Dam to Mexico)	Imperial Dam to Mexico	3,174	3,592	2,802	372	Alfalfa	350	1,833				
						Bermuda/Grass	86	286				
						Citrus	830	2,735				
						Cotton	258	892				
						Crucifers	48	17				
						Dates	339	1,954				
						Legume/Solanum Veg.	3	9				
						Lettuce	929	393				
						Miscellaneous herbs	31	88				
						Small Grains	350	572				
						Small Vegetables	128	141				
						Sudan	242	867				
						Total	3,592	9,785	3,256	8,476	62	373
State of Arizona - Limitrophe Section	Imperial Dam to Mexico	793	830	712	81	Bermuda/Grass	270	899				
						Cotton	197	683				
						Crucifers	49	24				
						Dates	6	34				
						Legume/Solanum Veg.	16	40				
						Lettuce	87	31				
						Melons	27	46				
						Small Grains	101	165				
						Sudan	79	282				
						Total	830	2,203	1,134	2,031	4	22
State of Arizona - Downgradient from YMIDD	Imperial Dam to Mexico	7,496	7,493	6,493	1,003	Alfalfa	317	1,524				
						Bermuda/Grass	6	19				
						Citrus	729	2,588				
						Dates	1,978	11,443				
						Field Grain	1	2				
						Small Grains	2,874	4,030				
						Sudan	1,588	5,696				
						Total	7,493	25,302	-	-	-	-
State of Arizona - Gila River Valley*	Imperial Dam to Mexico	2,891	1,089	1,120	1,771	Alfalfa	459	2,266				
						Bermuda/Grass	34	-				
						Dates	328	1,721				
						Jojoba	234	1,086				
						Sudan	34	111				
						Total	1,089	5,183	6	15	-	-

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**Other Water Users Not Reported on Individual Fact Sheets
2010**

Water User	River Reach	Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
		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	67	66	19	Alfalfa	1	3				
						Citrus	45	152				
						Dates	2	9				
						Deciduous Orchards	5	23				
						Legume/Solanum Veg.	2	4				
						Lettuce	1	0				
						Nursery/Greenhouse	1	3				
						Small Grains	8	13				
						Sudan	2	7				
						Total	67	214				
Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	-	-	183	381	-	-
California												
Bernal Farm	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	-	-	259	706	-	-
Chemehuevi Indian Reservation, CA	Davis Dam to Parker Dam	58	-	-	58		-	-				
						Total	-	-	23	29		
Cibola National Wildlife Refuge, CA	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	-	-	4,064	10,855	160	824
Clark Farm	Parker Dam to Imperial Dam	113	6	6	107	Alfalfa	6	28				
						Total	6	28	35	76	-	-
Colorado River Indian Reservation - CA	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	-	-	8,681	21,063	71	367
Fort Yuma Indian Reservation, CA	Imperial Dam to Mexico	1,309	1,121	689	621	Alfalfa	17	13				
						Crucifers	74	44				
						Dates	2	9				
						Legume/Solanum Veg.	10	26				
						Lettuce	685	361				
						Melons	52	89				
						Miscellaneous Herbs	83	238				
						Root Vegetables	22	22				
						Small Vegetables	30	40				
						Sudan	146	524				
						Total	1,121	1,367	3,495	8,165	37	222
Fort Yuma Indian Reservation and Picacho Recreation Area	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	-	-	23	30	-	-
Fort Yuma Indian Reservation and Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	-	-	197	471	<1	1
Havasu National Wildlife Refuge	Davis Dam to Parker Dam	-	-	-	-		-	-				
						Total	-	-	1,507	4,730	234	1,084
Imperial National Wildlife Refuge (Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	-	-	-	-		-	-				
						Total	-	-	5,264	1,556	1,000	5,160
Imperial National Wildlife Refuge (Imperial Dam to Mexico)	Imperial Dam to Mexico	-	-	-	-		-	-				
						Total	-	-	23	28	-	-

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**Other Water Users Not Reported on Individual Fact Sheets
2010**

Water User	River Reach	Agricultural Acreage				Agriculture			Riparian Vegetation		Open Water	
		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	Parker Dam to Imperial Dam	-	-	-	-	-	-	-	11	26	-	-
						Total	-	-				
Moabi Regional Park	Davis Dam to Parker Dam	-	-	-	-	-	-	-	108	148	-	-
						Total	-	-				
North Lyn-de Farm	Parker Dam to Imperial Dam	145	145	145	-	Alfalfa	144	646				
						Bermuda/Grass	1	2				
						Total	145	648	1	<1	-	-
Picacho State Recreation Area - CA (Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	-	-	-	-	-	-	-	1,219	3,273	94	486
						Total	-	-				
Picacho State Recreation Area - CA (Imperial Dam to Mexico)	Imperial Dam to Mexico	-	-	-	-	-	-	-	257	712	2	11
						Total	-	-				
South Lyn-De Farm	Parker Dam to Imperial Dam	310	132	136	174	Alfalfa	132	694				
						Total	132	694	-	-	-	-
State of California (Other users, Davis Dam to Parker Dam)	Davis Dam to Parker Dam	362	-	-	362	-	-	-	5,047	10,735	79	365
						Total	-	-				
State of California (Other users, Parker Dam to Imperial Dam)	Parker Dam to Imperial Dam	1,430	416	416	1,013	Citrus	146	442				
						Dates	215	1,196				
						Deciduous Orchards	1	5				
						Grapes	52	156				
						Melons	1	1				
						Total	416	1,800	7,671	17,679	308	1,589
State of California (Other users, Imperial Dam to Mexico)	Imperial Dam to Mexico	1,969	1,314	1,106	862	Alfalfa	139	723				
						Bermuda/Grass	21	70				
						Citrus	27	97				
						Crucifers	153	56				
						Lettuce	678	326				
						Melons	55	95				
						Small Vegetables	227	144				
						Sudan	14	51				
						Total	1,314	1,562	800	1,747	38	229
Yuma Proving Ground	Imperial Dam to Mexico	-	-	-	-	-	-	-	1,913	5,577	4	21
						Total	-	-				
Nevada												
Lake Mead National Recreation Area - NV (Hoover Dam to Davis Dam)	Hoover Dam to Davis Dam	-	-	-	-	-	-	-	57	130	44	205
						Total	-	-				
Lake Mead National Recreation Area - NV (Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-	-	-	-	31	60	-	-
						Total	-	-				
State of Nevada - Davis to Parker (Davis Dam to Parker Dam)	Davis Dam to Parker Dam	-	-	-	-	-	-	-	3,935	7,529	52	241
						Total	-	-				

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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
2010**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	2.83	2.78	4.88	6.45	8.61	9.13	9.09	8.49	6.07	4.52	3.73	2.26	68.84
Precipitation	2.90	1.28	1.01	0.21	0.00	0.13	0.00	0.87	0.00	0.93	0.01	2.00	9.36

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.41	2.83	3.74	5.96	7.95	7.87	8.03	7.95	6.4	3.47	2.9	2.47	61.98
Bermuda/Grass	0	0	0	2.7	7.02	7.78	7.76	7.12	4.95	0.24	0	0	37.57
Bermuda Overseeded with Rye in Winter	2.51	2.33	3.73	2.7	7.02	7.78	7.76	7.12	4.95	2.09	3.27	2	53.26
Citrus - Declining	1.34	1.35	2.19	2.76	3.52	3.63	3.63	3.38	2.48	1.95	1.74	1.09	29.06
Citrus - Mature	1.94	1.85	3.13	3.97	5.05	5.23	5.22	4.86	3.52	2.83	2.49	1.59	41.68
Citrus - Young	1.16	1.1	1.86	2.37	3.01	3.13	3.13	2.95	2.13	1.69	1.48	0.98	24.99
Cotton	0	0	0	0.89	2.22	5.17	8.35	9.48	6.01	0.52	0	0	32.64
Crucifers (Fall, Early)	0	0	0	0	0	0	0	0	0	2.04	2.17	2.1	6.31
Crucifers (Fall, Late)	0	0	0	0	0	0	0	0	0	0.15	1.69	1.38	3.22
Crucifers (Spring, Early)	2.83	2.7	0.41	0	0	0	0	0	0	0	0	0	5.94
Crucifers (Spring, Late)	2.68	2.78	4.64	0	0	0	0	0	0	0	0	0	10.1
Dates	2.43	2.5	4.84	6.45	8.61	9.12	8.8	8.18	5.77	4.23	3.47	2.11	66.51
Deciduous Orchards	1.3	1.29	2.79	4.71	7.4	7.93	7.9	7.4	5.28	3.92	3.16	1.4	54.48
Fall Melons	0	0	0	0	0	0	0	1.44	3.58	4.45	3.73	1.28	14.48
Field Grain	0	0	1.68	5.8	10.31	9.59	1.39	0	0	0	0	0	28.77
Grapes	0	0.19	1.51	4.12	7.26	7.74	7.33	5.38	1.66	0	0	0	35.19
Legume/Solanum Vegetables (Fall)	0	0	0	0	0	0	0	0	0	1.29	2.64	2.22	6.15
Legume/Solanum Vegetables (Spring)	2.96	2.85	1.38	0	0	0	0	0	0	0	0	0	7.19
Lettuce (Fall, Early)	0	0	0	0	0	0	0	0	0	2.77	3.27	0	6.04
Lettuce (Spring, Late)	2.56	2.78	1.54	0	0	0	0	0	0	0	0	0	6.88
Miscellaneous herbs	2.57	2.52	0.72	0	0	0	0	0	0	0.93	2.12	2	10.86
Moist Soil Unit	2.83	2.78	4.75	6.38	5.01	2.94	9.74	9.61	4.18	4.52	3.73	2.26	58.73
Nursery or greenhouse	1.16	1.1	1.86	2.37	3.01	3.13	3.13	2.95	2.13	1.69	1.48	0.98	24.99
Oil Crops	0	1.06	3.8	7.57	10.66	10.14	1.73	0	0	0	0	0	34.96
Perennial Vegetables	1.26	1.19	2.25	4.69	8	8.53	8.47	7.87	4.97	2.88	1.69	0.99	52.79
Root Vegetables	0	0	0	0	0	0	0	0	2.14	3.34	3.93	2.11	11.52
Small Grains (Fall)	0	0	0	0	0	0	0	0	0	0	0.34	0.82	1.16
Small Grains (Spring)	2.3	3.18	5.49	7.05	2.84	0	0	0	0	0	0	0	20.86
Small Vegetables (Fall)	0	0	0	0	0	0	0	0	1	1.79	2.82	2.26	7.87
Small Vegetables (Spring)	2.83	2.78	4.03	0	0	0	0	0	0	0	0	0	9.64
Spring Melons	0	0.28	3.28	6.32	8.53	5.26	0	0	0	0	0	0	23.67
Sudan	0	0	2.56	6.55	9.77	10.4	10.08	1.38	0	0	0	0	40.74
Sugar Beets (Summer)	3.03	2.99	5.24	6.68	6.35	0.18	0	0	0	0	0	0	24.47
Sugar Beets (Fall)	0	0	0	0	0	0	0	0	0.67	1.65	2.38	2.15	6.85
Tomatoes	0	1.69	4.3	7.59	9.62	3.88	0	0	0	0	0	0	27.08

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	2.5	2.37	4.27	6.13	7.98	7.78	7.32	6.48	4.42	3.5	3.29	1.83	57.87

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	0.57	0.57	1.61	2.96	4.76	5.11	5.06	4.66	2.75	1.57	0.85	0.44	30.91
barren	0.57	0.47	0.71	0.88	1.15	1.23	1.2	1.18	0.79	0.64	0.66	0.44	9.92
cw	0.94	0.93	2.39	4.81	8.5	9.32	9.25	8.56	6.07	4.09	2.07	0.54	57.47
low veg	0.57	0.57	1.61	2.96	4.76	5.11	5.06	4.66	2.75	1.57	0.85	0.44	30.91
marsh	0.74	0.73	4	7.67	10.26	10.85	10.79	10.1	7.13	2.66	0.94	0.6	66.47
ms_aw	0.89	0.86	1.84	3.02	4.58	4.89	4.82	4.03	2.44	1.49	1.11	0.68	30.65
ms_high	0.62	0.63	1.44	3.24	6.17	6.89	6.87	6.43	4.6	2.7	1.29	0.5	41.38
ms_low	0.89	0.86	1.84	3.02	4.58	4.89	4.82	4.03	2.44	1.49	1.11	0.68	30.65
sc/ms	0.62	0.63	1.44	3.24	6.17	6.89	6.87	6.43	4.6	2.7	1.29	0.5	41.38
sc_aw	0.89	0.86	1.84	3.02	4.58	4.89	4.82	4.03	2.44	1.49	1.11	0.68	30.65
sc_high	0.62	0.63	1.44	3.24	6.17	6.89	6.87	6.43	4.6	2.7	1.29	0.5	41.38
sc_low	0.89	0.86	1.84	3.02	4.58	4.89	4.82	4.03	2.44	1.49	1.11	0.68	30.65
sc_ms_aw	0.89	0.86	1.84	3.02	4.58	4.89	4.82	4.03	2.44	1.49	1.11	0.68	30.65

**Parker Area ET Rate Table
2010**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	2.52	2.85	5.10	6.50	8.10	9.08	9.58	8.93	6.87	4.94	3.25	1.98	69.7
Precipitation	1.55	0.29	0.33	0.00	0.00	0.00	0.00	0.08	0.00	0.24	0.01	0.63	3.14

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.04	2.9	3.94	5.99	7.43	7.88	8.42	8.37	7.18	3.82	2.55	2.17	62.69
Bermuda/Grass	0	0	0	2.72	6.61	7.75	8.15	7.43	5.55	0.27	0	0	38.48
Bermuda Overseeded with Rye in Winter	2.2	2.41	3.89	2.72	6.61	7.75	8.15	7.43	5.55	2.3	2.86	1.73	53.6
Citrus - Declining	1.19	1.37	2.29	2.8	3.31	3.64	3.82	3.59	2.8	2.16	1.51	0.95	29.43
Citrus - Mature	1.75	1.88	3.25	3.99	4.75	5.16	5.48	5.12	3.98	3.1	2.14	1.4	42
Citrus - Young	1	1.13	1.95	2.42	2.89	3.12	3.3	3.09	2.4	1.86	1.29	0.84	25.29
Cotton	0	0	0	0.93	2.06	5.22	8.81	9.99	6.79	0.68	0	0	34.48
Crucifers (Fall, Early)	0	0	0	0	0	0	0	0	0	2.22	1.89	1.83	5.94
Crucifers (Fall, Late)	0	0	0	0	0	0	0	0	0	0.19	1.48	1.25	2.92
Crucifers (Spring, Early)	2.52	2.75	0.45	0	0	0	0	0	0	0	0	0	5.72
Crucifers (Spring, Late)	2.4	2.85	4.85	0	0	0	0	0	0	0	0	0	10.1
Dates	2.19	2.57	5.04	6.5	8.1	9.07	9.27	8.62	6.57	4.63	2.96	1.82	67.34
Deciduous Orchards	1.19	1.3	2.92	4.77	6.97	7.86	8.32	7.74	5.97	4.29	2.72	1.24	55.29
Fall Melons	0	0	0	0	0	0	0	1.51	4.09	4.84	3.25	1.1	14.79
Farm Pond	2.2	2.41	4.44	6.2	7.48	7.75	7.75	6.79	5.03	3.83	2.88	1.59	58.35
Field Grain	0	0	1.78	5.85	9.71	9.51	1.41	0	0	0	0	0	28.26
Grapes	0	0.19	1.54	4.18	6.85	7.71	7.73	5.66	1.86	0	0	0	35.72
Legume/Solanum Vegetables (Fall)	0	0	0	0	0	0	0	0	0	1.55	2.31	1.93	5.79
Legume/Solanum Vegetables (Spring)	2.58	2.91	1.61	0	0	0	0	0	0	0	0	0	7.1
Lettuce (Fall, Early)	0	0	0	0	0	0	0	0	0	3	2.87	0	5.87
Lettuce (Spring, Late)	2.33	2.85	1.77	0	0	0	0	0	0	0	0	0	6.95
Miscellaneous herbs	2.23	2.57	0.84	0	0	0	0	0	0	1.09	1.83	1.75	10.31
Moist Soil Unit	2.52	2.85	5	6.42	4.76	2.99	10.31	10.07	4.69	4.94	3.25	1.98	59.78
Nursery or greenhouse	1	1.13	1.95	2.42	2.89	3.12	3.3	3.09	2.4	1.86	1.29	0.84	25.29
Oil Crops	0	1.1	3.93	7.63	10.01	10.04	1.84	0	0	0	0	0	34.55
Perennial Vegetables	1.06	1.22	2.37	4.75	7.51	8.48	8.96	8.31	5.68	3.17	1.46	0.85	53.82
Root Vegetables	0	0	0	0	0	0	0	0	2.43	3.68	3.43	1.81	11.35
Small Grains (Fall)	0	0	0	0	0	0	0	0	0	0	0.27	0.72	0.99
Small Grains (Spring)	2.1	3.25	5.76	7.12	2.73	0	0	0	0	0	0	0	20.96
Small Vegetables (Fall)	0	0	0	0	0	0	0	0	1.17	1.96	2.44	1.98	7.55
Small Vegetables (Spring)	2.52	2.85	4.27	0	0	0	0	0	0	0	0	0	9.64
Spring Melons	0	0.31	3.4	6.38	8.04	5.13	0	0	0	0	0	0	23.26
Sudan	0	0	2.62	6.63	9.22	10.32	10.59	1.45	0	0	0	0	40.83
Sugar Beets (Summer)	2.77	3.11	5.45	6.74	5.99	0.16	0	0	0	0	0	0	24.22
Sugar Beets (Fall)	0	0	0	0	0	0	0	0	0.76	1.76	2.02	1.89	6.43
Tomatoes	0	1.74	4.43	7.63	9.08	3.73	0	0	0	0	0	0	26.61

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	1.68	2.08	4.25	6.03	7.39	8.48	8.82	8.27	6.35	4.81	3.25	1.51	62.92

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	0.52	0.59	1.66	3	4.52	5.1	5.35	4.88	3.14	1.69	0.79	0.39	31.63
barren	0.52	0.5	0.68	0.87	1.12	1.23	1.27	1.19	0.93	0.72	0.59	0.39	10.01
cw	0.84	0.97	2.49	4.87	7.93	9.28	9.8	9.06	6.87	4.48	1.8	0.49	58.88
low veg	0.52	0.59	1.66	3	4.52	5.1	5.35	4.88	3.14	1.69	0.79	0.39	31.63
marsh	0.67	0.73	4.13	7.71	9.63	10.79	11.38	10.6	8.14	2.93	0.83	0.51	68.05
ms_aw	0.75	0.87	1.93	3.02	4.29	4.84	5.13	4.2	2.75	1.62	0.95	0.61	30.96
ms_high	0.58	0.66	1.48	3.28	5.8	6.85	7.21	6.72	5.19	2.95	1.16	0.47	42.35
ms_low	0.75	0.87	1.93	3.02	4.29	4.84	5.13	4.2	2.75	1.62	0.95	0.61	30.96
sc/ms	0.58	0.66	1.48	3.28	5.8	6.85	7.21	6.72	5.19	2.95	1.16	0.47	42.35
sc_aw	0.75	0.87	1.93	3.02	4.29	4.84	5.13	4.2	2.75	1.62	0.95	0.61	30.96
sc_high	0.58	0.66	1.48	3.28	5.8	6.85	7.21	6.72	5.19	2.95	1.16	0.47	42.35
sc_low	0.75	0.87	1.93	3.02	4.29	4.84	5.13	4.2	2.75	1.62	0.95	0.61	30.96
sc_ms_aw	0.75	0.87	1.93	3.02	4.29	4.84	5.13	4.2	2.75	1.62	0.95	0.61	30.96

**Wellton-Mohawk Area ET Rate Table
2010**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	2.24	2.62	4.86	6.27	8.06	8.60	8.69	8.49	6.61	4.65	3.18	1.88	66.15
Precipitation	1.65	0.91	0.45	0.05	0.00	0.00	0.00	0.26	0.02	0.23	0.00	0.25	3.81

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	1.76	2.64	4.07	5.08	6.76	7.62	7.82	7.58	5.57	4.9	2.63	2.02	58.45
Bermuda/Grass	0	0	0	2.61	6.56	7.26	7.37	7.07	5.37	0.36	0	0	36.6
Bermuda Overseeded with Rye in Winter	1.93	2.24	3.78	2.61	6.56	7.26	7.37	7.07	5.37	2.16	2.76	1.62	50.73
Citrus - Declining	1.05	1.23	2.19	2.68	3.31	3.44	3.48	3.39	2.67	1.99	1.5	0.94	27.87
Citrus - Mature	1.56	1.75	3.12	3.84	4.72	4.91	4.97	4.84	3.84	2.9	2.12	1.33	39.9
Citrus - Young	0.93	1.05	1.88	2.31	2.84	2.94	3.01	2.94	2.33	1.75	1.29	0.81	24.08
Cotton	0	0	0.77	1.62	3.15	5.81	8.37	9.5	6.48	1.71	0	0	37.41
Crucifers (Fall, Early)	0	0	0	0	0	0	0	0	0.24	1.66	1.75	1.75	5.4
Crucifers (Fall, Late)	0	0	0	0	0	0	0	0	0	0	1.13	0.98	2.11
Crucifers (Spring, Early)	2.24	0.62	0	0	0	0	0	0	0	0	0	0	2.86
Crucifers (Spring, Late)	2.03	2.62	2.04	0	0	0	0	0	0	0	0	0	6.69
Dates	1.89	2.31	4.69	6.27	7.95	8.3	8.38	8.18	6.31	4.41	3.05	1.87	63.61
Deciduous Orchards	0.85	1	2.53	4.38	6.8	7.36	7.41	7.23	5.64	3.95	2.63	1.17	50.95
Fall Melons	0	0	0	0	0	0	0	0	3.27	4.03	3.18	1.7	12.18
Farm Pond	1.93	2.26	4.23	5.97	7.46	7.36	7.01	6.48	4.82	3.61	2.82	1.52	55.47
Field Grain	0	0.51	2.86	7.04	9.57	6.6	0	0	0	0	0	0	26.58
Grapes	0	0.18	1.46	4.03	6.82	7.33	7	5.35	1.82	0	0	0	33.99
Joba Beans	2.55	2.76	2.88	0.17	3.92	7.13	9.57	9.41	7.27	5.14	3.51	2.14	56.45
Legume/Solanum Vegetables	0	0	0	1.65	5.02	8.35	8.98	3.5	0	0	0	0	27.5
Legume/Solanum Vegetables (Fall)	0	0	0	0	0	0	0	0	0	1.09	1.93	1.8	4.82
Legume/Solanum Vegetables (Spring)	2.26	2.63	1.57	0	0	0	0	0	0	0	0	0	6.46
Lettuce (Fall, Early)	0	0	0	0	0	0	0	0	1.67	3.33	2.97	0	7.97
Lettuce (Fall, Late)	0	0	0	0	0	0	0	0	0	0	0	1.32	1.32
Lettuce (Spring, Early)	2.15	1.32	0	0	0	0	0	0	0	0	0	0	3.47
Lettuce (Spring, Late)	0.84	2.34	4.77	0.13	0	0	0	0	0	0	0	0	8.08
Miscellaneous herbs	1.94	2.36	1.42	0	0	0	0	0	0	1.27	2.14	1.66	10.79
Moist Soil Unit	2.24	2.62	4.79	6.2	4.76	2.82	9.26	9.57	4.56	4.65	3.18	1.88	56.53
Nursery or greenhouse	0.93	1.05	1.88	2.31	2.84	2.94	3.01	2.94	2.33	1.75	1.29	0.81	24.08
Oil Crops	0	0.95	3.68	7.31	9.9	9.44	1.83	0	0	0	0	0	33.11
Perennial Vegetables	0.87	1.05	2.1	4.48	7.41	8	8.04	7.86	5.4	3.02	1.51	0.73	50.47
Root Vegetables	0	0	0	0	0	0	0	0	2.44	3.41	3.3	1.73	10.88
Small Grains (Fall)	0	0	0	0	0	0	0	0	0	0	0	0.64	0.64
Small Grains (Spring)	2.03	2.93	5.41	5.97	2.42	0	0	0	0	0	0	0	18.76
Small Vegetables (Fall)	0	0	0	0	0	0	0	0	0	1.2	1.91	1.6	4.71
Small Vegetables (Spring)	2.24	2.62	4.79	5.2	0	0	0	0	0	0	0	0	14.85
Small Vegetables (Spring, Late)	1.67	2.05	4.51	5.55	3.66	0.85	0	0	0	0	0	0	18.29
Spring Melons	0	1.92	4.34	6.27	7.56	0	0	0	0	0	0	0	20.09
Sudan	0	0	0	2.63	7.85	9.76	9.85	9.28	0	0	0	0	39.37
Sugar Beets (Summer)	2.28	2.8	5.16	6.4	5.93	0.17	0	0	0	0	0	0	22.74
Sugar Beets (Fall)	0	0	0	0	0	0	0	0	0.74	1.68	1.98	1.79	6.19
Tomatoes	0	1.63	4.21	7.34	9	3.61	0	0	0	0	0	0	25.79

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	1.91	2.58	5.01	6.57	8.37	8.9	9	8.8	6.67	4.65	2.78	1.36	66.6

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	0.41	0.56	1.59	2.94	4.51	4.82	4.86	4.66	3.02	1.62	0.75	0.36	30.1
barren	0.41	0.48	0.71	0.88	1.1	1.18	1.19	1.19	0.92	0.65	0.58	0.36	9.65
cw	0.74	0.87	2.31	4.7	7.88	8.74	8.79	8.53	6.61	4.22	1.82	0.45	55.66
low veg	0.41	0.56	1.59	2.94	4.51	4.82	4.86	4.66	3.02	1.62	0.75	0.36	30.1
marsh	0.63	0.68	3.91	7.49	9.58	10.24	10.31	10.08	7.81	2.89	0.77	0.52	64.91
ms_aw	0.67	0.78	1.84	2.91	4.27	4.57	4.59	4.04	2.67	1.53	0.97	0.59	29.43
ms_high	0.52	0.58	1.38	3.17	5.76	6.5	6.56	6.41	4.98	2.79	1.16	0.42	40.23
ms_low	0.67	0.78	1.84	2.91	4.27	4.57	4.59	4.04	2.67	1.53	0.97	0.59	29.43
sc/ms	0.52	0.58	1.38	3.17	5.76	6.5	6.56	6.41	4.98	2.79	1.16	0.42	40.23
sc_aw	0.67	0.78	1.84	2.91	4.27	4.57	4.59	4.04	2.67	1.53	0.97	0.59	29.43
sc_high	0.52	0.58	1.38	3.17	5.76	6.5	6.56	6.41	4.98	2.79	1.16	0.42	40.23
sc_low	0.67	0.78	1.84	2.91	4.27	4.57	4.59	4.04	2.67	1.53	0.97	0.59	29.43
sc_ms_aw	0.67	0.78	1.84	2.91	4.27	4.57	4.59	4.04	2.67	1.53	0.97	0.59	29.43

**Yuma Area ET Rate Table
2010**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	2.81	3.00	5.32	6.32	8.16	9.19	10.28	9.49	7.45	5.08	3.59	2.27	72.96
Precipitation	2.83	0.66	0.81	0.01	0.00	0.00	0.00	0.37	0.00	0.13	0.00	0.20	5.03

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	2.27	3.04	4.48	5.08	6.81	8.09	9.12	8.37	6.15	5.39	3.01	2.44	64.25
Bermuda/Grass	0	0	0	2.65	6.63	7.78	8.68	7.92	6.07	0.28	0	0	40.01
Bermuda Overseeded with Rye in Winter	2.5	2.56	4.11	2.65	6.63	7.78	8.68	7.92	6.07	2.33	3.13	1.99	56.35
Citrus - Declining	1.32	1.41	2.37	2.72	3.35	3.69	4.1	3.78	3.07	2.24	1.68	1.1	30.83
Citrus - Mature	1.94	2	3.39	3.89	4.8	5.23	5.88	5.43	4.33	3.17	2.4	1.59	44.05
Citrus - Young	1.16	1.23	2.01	2.35	2.85	3.17	3.53	3.26	2.58	1.91	1.41	0.99	26.45
Cotton	0	0	0.86	1.64	3.14	6.24	9.94	10.66	7.29	1.77	0	0	41.54
Crucifers (Fall, Early)	0	0	0	0	0	0	0	0	0.28	1.8	2.01	2.11	6.2
Crucifers (Fall, Late)	0	0	0	0	0	0	0	0	0	0	1.3	1.15	2.45
Crucifers (Spring, Early)	2.81	0.69	0	0	0	0	0	0	0	0	0	0	3.5
Crucifers (Spring, Late)	2.5	3	2.21	0	0	0	0	0	0	0	0	0	7.71
Dates	2.32	2.6	5.14	6.32	8.06	8.89	9.97	9.18	7.15	4.81	3.38	2.21	70.03
Deciduous Orchards	1.07	1.18	2.77	4.43	6.87	7.81	8.73	8.08	6.34	4.29	2.98	1.43	55.98
Fall Melons	0	0	0	0	0	0	0	0	3.67	4.45	3.59	2.05	13.76
Farm Pond	2.5	2.55	4.62	6.02	7.54	7.81	8.33	7.23	5.46	3.97	3.18	1.82	61.03
Field Grain	0	0.6	3.15	7.09	9.7	7.05	0	0	0	0	0	0	27.59
Grapes	0	0.19	1.6	4.06	6.89	7.8	8.3	6.03	2.03	0	0	0	36.9
Legume/Solanum Vegetables	0	0	0	1.72	5.09	9	10.75	3.91	0	0	0	0	30.47
Legume/Solanum Vegetables (Fall)	0	0	0	0	0	0	0	0	0	1.28	2.2	2.16	5.64
Legume/Solanum Vegetables (Spring)	2.89	3.07	1.73	0	0	0	0	0	0	0	0	0	7.69
Lettuce (Fall, Early)	0	0	0	0	0	0	0	0	1.99	3.72	3.35	0	9.06
Lettuce (Fall, Late)	0	0	0	0	0	0	0	0	0	0	0	1.58	1.58
Lettuce (Spring, Early)	2.68	1.53	0	0	0	0	0	0	0	0	0	0	4.21
Lettuce (Spring, Late)	0.88	2.67	5.23	0.14	0	0	0	0	0	0	0	0	8.92
Miscellaneous herbs	2.51	2.74	1.57	0	0	0	0	0	0	1.46	2.44	2.02	12.74
Moist Soil Unit	2.81	3	5.21	6.25	4.76	3.03	11	10.7	5.08	5.08	3.59	2.27	62.78
Nursery or greenhouse	1.16	1.23	2.01	2.35	2.85	3.17	3.53	3.26	2.58	1.91	1.41	0.99	26.45
Oil Crops	0	1.09	4.02	7.38	10.01	10.06	2.02	0	0	0	0	0	34.58
Perennial Vegetables	1.12	1.23	2.36	4.51	7.52	8.55	9.49	8.76	6.07	3.3	1.7	0.89	55.5
Root Vegetables	0	0	0	0	0	0	0	0	2.77	3.8	3.78	2.09	12.44
Small Grains (Fall)	0	0	0	0	0	0	0	0	0	0	0	0.78	0.78
Small Grains (Spring)	2.48	3.35	5.94	6.04	2.38	0	0	0	0	0	0	0	20.19
Small Vegetables (Fall)	0	0	0	0	0	0	0	0	0	1.35	2.13	1.93	5.41
Small Vegetables (Spring)	2.81	3	5.25	5.25	0	0	0	0	0	0	0	0	16.31
Small Vegetables (Spring, Late)	2.14	2.36	4.93	5.58	3.68	0.9	0	0	0	0	0	0	19.59
Spring Melons	0	2.21	4.75	6.32	7.65	0	0	0	0	0	0	0	20.93
Sudan	0	0	0	2.67	7.98	10.4	11.63	10.37	0	0	0	0	43.05
Sugar Beets (Summer)	2.98	3.22	5.62	6.44	6	0.16	0	0	0	0	0	0	24.42
Sugar Beets (Fall)	0	0	0	0	0	0	0	0	0.86	1.82	2.25	2.13	7.06
Tomatoes	0	1.84	4.6	7.41	9.12	3.79	0	0	0	0	0	0	26.76

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	2.42	2.92	5.49	6.62	8.47	9.49	10.62	9.8	7.56	5.08	3.15	1.69	73.31

Riparian Types	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
aw	0.57	0.61	1.74	2.92	4.54	5.13	5.74	5.22	3.37	1.75	0.83	0.45	32.87
barren	0.57	0.52	0.75	0.87	1.12	1.23	1.37	1.28	0.99	0.73	0.65	0.45	10.53
cw	0.93	1	2.56	4.73	7.99	9.39	10.55	9.71	7.5	4.59	1.99	0.54	61.48
low veg	0.57	0.61	1.74	2.92	4.54	5.13	5.74	5.22	3.37	1.75	0.83	0.45	32.87
marsh	0.74	0.78	4.28	7.53	9.71	10.9	12.22	11.31	8.81	3.04	0.87	0.58	70.77
ms_aw	0.83	0.92	1.98	2.94	4.31	4.89	5.48	4.51	2.98	1.66	1.08	0.71	32.29
ms_high	0.63	0.68	1.54	3.19	5.85	6.9	7.74	7.17	5.61	3.02	1.27	0.48	44.08
ms_low	0.83	0.92	1.98	2.94	4.31	4.89	5.48	4.51	2.98	1.66	1.08	0.71	32.29
sc/ms	0.63	0.68	1.54	3.19	5.85	6.9	7.74	7.17	5.61	3.02	1.27	0.48	44.08
sc_aw	0.83	0.92	1.98	2.94	4.31	4.89	5.48	4.51	2.98	1.66	1.08	0.71	32.29
sc_high	0.63	0.68	1.54	3.19	5.85	6.9	7.74	7.17	5.61	3.02	1.27	0.48	44.08
sc_low	0.83	0.92	1.98	2.94	4.31	4.89	5.48	4.51	2.98	1.66	1.08	0.71	32.29
sc_ms_aw	0.83	0.92	1.98	2.94	4.31	4.89	5.48	4.51	2.98	1.66	1.08	0.71	32.29

**IID and Coachella Area ET Rate Table
2010**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Reference ET	2.35	3.14	5.77	6.72	9.06	9.26	9.01	8.59	7.31	4.47	3.59	2.13	71.4
Precipitation	1.32	0.24	0.47	0.18	0.01	0.02	0.02	0.06	0.03	0.53	0.00	0.57	3.45

Crop	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Alfalfa	1.99	3.63	4.51	5.38	7.37	7.29	7.38	7.12	5.92	5.16	3.03	2.44	61.22
Aloe	0.95	1.24	2.21	2.49	3.17	3.17	3.1	2.96	2.59	1.68	1.42	0.9	25.88
Bermuda/Grass	0	0.08	5.1	6.42	8.75	8.96	8.69	8.28	6.51	0.49	0	0	53.28
Bermuda Overseeded with Rye in Winter	2.09	3	5.47	6.42	8.75	8.96	8.69	8.28	6.51	0.49	0	0.1	58.76
Cane/Bamboo	0.61	0.8	4.62	7.97	10.79	11	10.67	10.22	8.64	2.63	0.89	0.54	69.38
Citrus - Declining	1.12	1.47	2.58	2.89	3.7	3.7	3.64	3.44	2.96	1.95	1.69	1.05	30.19
Citrus - Mature	1.67	2.11	3.68	4.1	5.3	5.29	5.16	4.89	4.24	2.8	2.41	1.52	43.17
Citrus - Young	0.95	1.24	2.21	2.49	3.17	3.17	3.1	2.96	2.59	1.68	1.42	0.9	25.88
Cotton	0	0.07	1.65	1.89	4.39	7.6	10.17	8.53	4.1	0.44	0	0	38.84
Crucifers (Fall, Early)	0	0	0	0	0	0	0	3.54	3.03	4.44	4.3	2.1	17.41
Crucifers (Fall, Late)	0	0	0	0	0	0	0	0	2.79	1.59	3.24	2.56	10.18
Crucifers (Spring, Early)	0.72	0.02	0	0	0	0	0	0	0	0	0	0	0.74
Crucifers (Spring, Late)	2.44	1.14	0.14	0	0	0	0	0	0	0	0	0	3.72
Dates	1.97	2.71	5.59	6.71	8.87	8.96	8.7	8.28	7.01	4.21	3.37	2.12	68.5
Deciduous Orchards	0.88	1.22	2.99	4.74	7.63	7.89	7.73	7.3	6.21	3.81	2.97	1.34	54.71
Farm Pond	2.56	3.39	6.13	7.18	9.69	9.87	9.64	9.19	7.87	4.77	3.88	2.25	76.42
Field Grain	0	0.87	2.78	6.71	10.82	9.66	3.57	0.28	0	0	0	0	34.69
Grapes	0	0.2	1.71	4.38	7.65	7.87	7.29	5.45	1.97	0	0	0	36.52
Jojoba Beans	2.61	3.31	3.33	0.21	4.34	7.76	9.94	9.48	8.08	4.94	3.94	2.41	60.35
Legume/Solanum Vegetables	0	0	2.32	4.44	10.63	8.71	3.88	0.12	0	0	0	0	30.1
Legume/Solanum Vegetables (Fall)	0	0	0	0	0	0	0	0	0	1.07	1.7	2.11	4.88
Legume/Solanum Vegetables (Spring)	2.59	3	5.47	1.86	0	0	0	0	0	0	0	0	12.92
Lettuce (Fall, Early)	0	0	0	0	0	0	0	0	0	3.52	3.88	2.25	9.65
Lettuce (Fall, Late)	0	0	0	0	0	0	0	0	0	0.27	3.04	2.27	5.58
Lettuce (Spring, Early)	2.56	0.99	0.01	0	0	0	0	0	0	0	0	0	3.56
Lettuce (Spring, Late)	2.56	3.39	5.72	0.74	0	0	0	0	0	0	0	0	12.41
Marsh Maintained	0.61	0.8	4.62	7.97	10.79	11	10.67	10.22	8.64	2.63	0.89	0.54	69.38
Melons (Fall)	0	0	0	0	0	0	0.51	4.15	4.19	4.66	3.71	1.49	18.71
Melons (Spring)	0.09	1.42	5.91	6.68	5.95	0.95	0	0	0	0	0	0	21
Miscellaneous herbs	0.16	1.42	4.09	7.93	8.49	3.92	0.37	0	0	0	0	0	26.38
Moist Soil Unit	2.35	3.14	5.65	6.63	5.27	3.07	9.58	9.69	4.95	4.47	3.59	2.13	60.52
Nursery or greenhouse	0.95	1.24	2.21	2.49	3.17	3.17	3.1	2.96	2.59	1.68	1.42	0.9	25.88
Oil Crops	0.16	1.42	4.09	7.93	8.49	3.92	2.13	0	0	0	0	0	28.14
Perennial Vegetables	0.46	0	1.65	3.41	8.34	8.75	8.61	8.17	7.01	4.19	3.33	1.78	55.7
Root Vegetables	0.48	0	0	0	0	0	0	0	0.77	1.66	3.33	2.27	8.51
Small Grains (Fall)	0	0	0	0	0	0	0	0	0	0	0.07	0.95	1.02
Small Grains (Spring)	2.23	3.67	6.88	6.9	3.76	0.3	0	0	0	0	0	0	23.74
Small Vegetables (Fall)	0	0	0	0	0	0	0	0	0.12	1.66	2.31	2.04	6.13
Small Vegetables (Spring)	2.42	3.16	5.23	5.09	1	0	0	0	0	0	0	0	16.9
Small Vegetables (Spring, Late)	1.76	2.44	5.34	5.9	4.08	0.9	0	0	0	0	0	0	20.42
Sudan	0	0	0.3	2.87	9.01	11.03	9.17	4.28	0.26	0	0	0	36.92
Sugar Beets (Summer)	2.67	3.59	6.28	6.5	5.95	2.42	0.32	0	0	0	0	0	27.73
Sugar Beets (Fall)	0	0	0	0	0	0	0	0	0.19	1.69	2.07	2.08	6.03
Tomatoes	0.16	1.42	4.09	7.93	8.49	3.92	0.37	0	0	0	0	0	26.38
Wildlife Forage Maintained	2.23	3.67	6.88	6.9	3.76	0.3	0	0	0	0	0.07	0.95	24.76

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (Inches)
Open Water	2.56	3.39	6.13	7.18	9.69	9.87	9.64	9.19	7.87	4.77	3.88	2.25	76.42
All American Canal*	2.03	3	5.99	7.02	9.37	9.56	9.33	8.9	7.43	4.47	3.11	1.59	71.8

*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

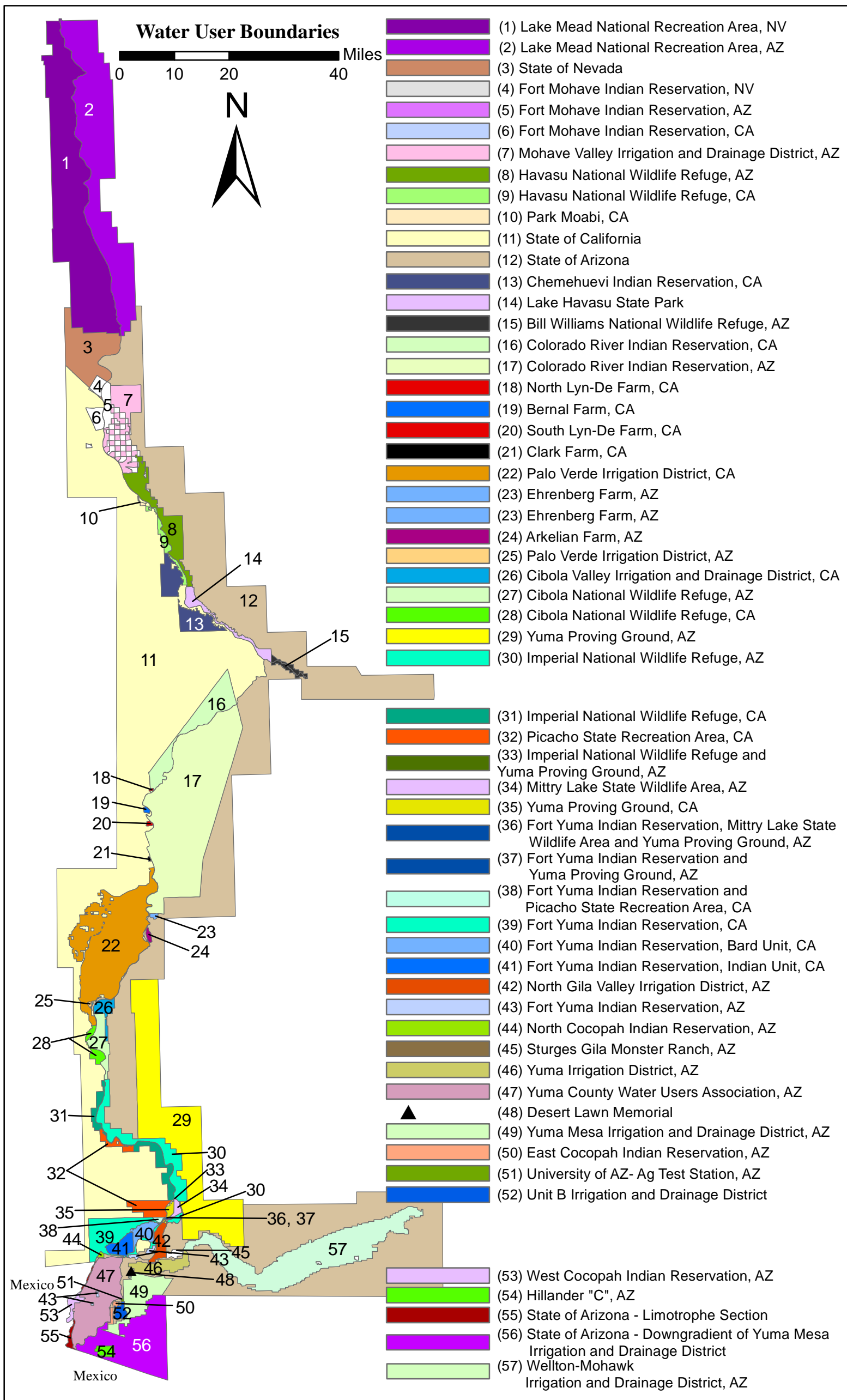


Exhibit 2

Hoover Dam to Davis Dam

- Agricultural fields in the program
- Riparian vegetation in the program

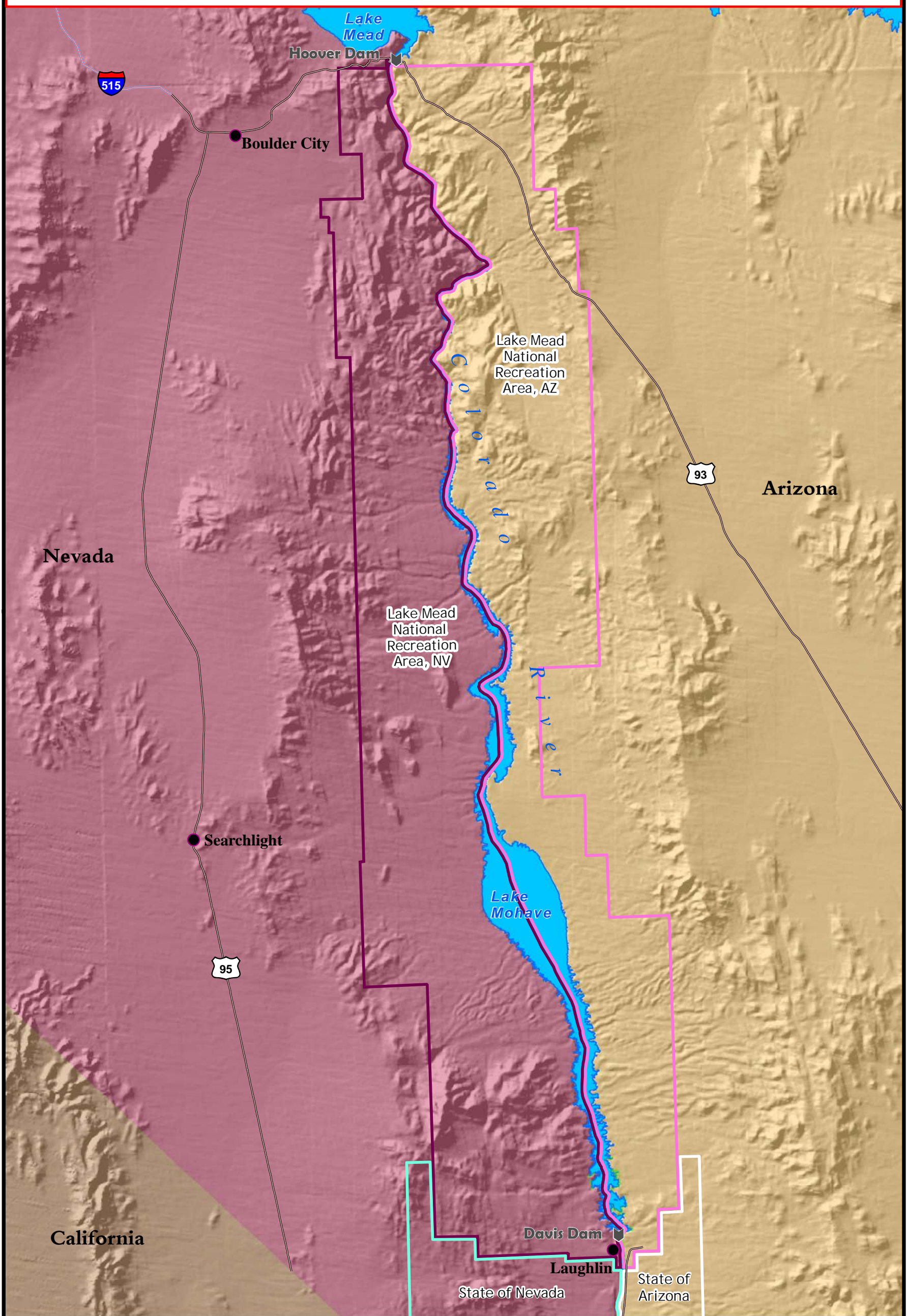


Exhibit 3

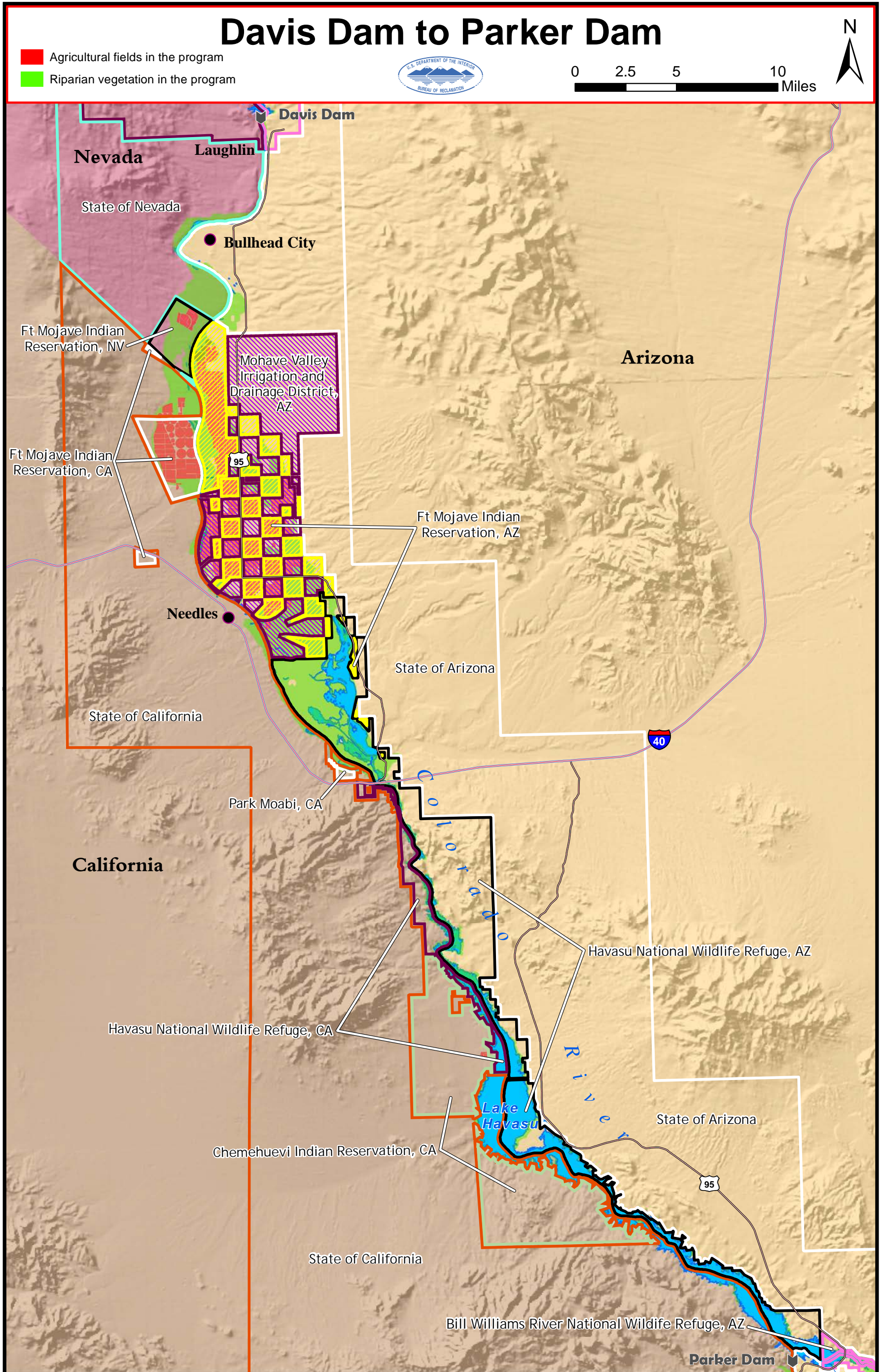


Exhibit 4

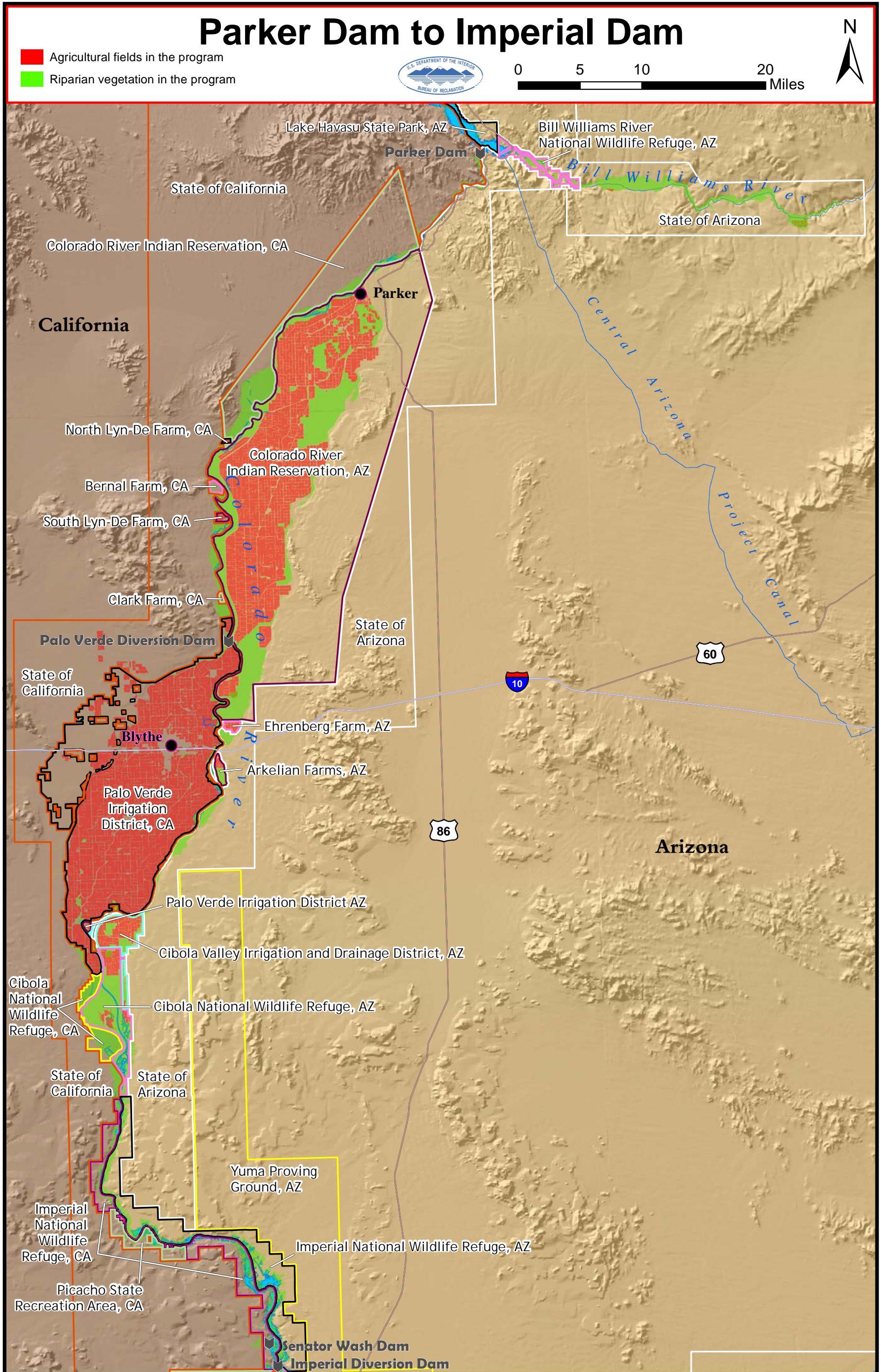


Exhibit 5

Imperial Irrigation District and Coachella Valley Water District

- Agricultural fields in the program
- Riparian vegetation in the program

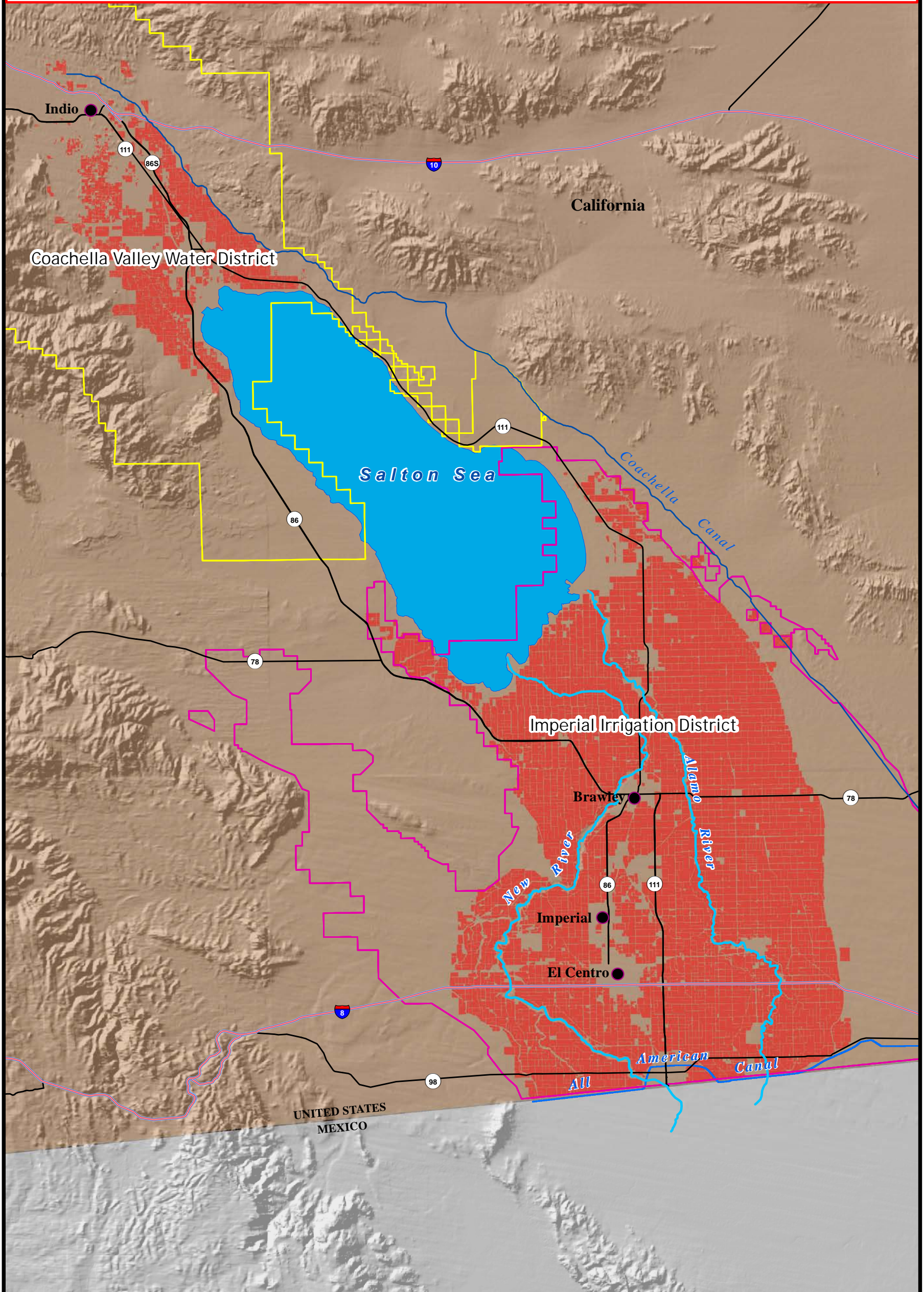
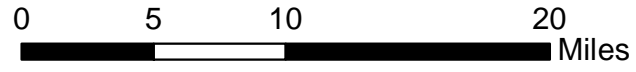


Exhibit 6

