

Cachuma Project Water Rights Hearing

October 2003

Panel III

Presenter:

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Agricultural and Civil Engineer

Stetson Engineers Inc.

Introduction

- Define “Agricultural Water Use Efficiency”
- Present The Calculations
- Present the Results

Agricultural Water Use Efficiency Defined

- Amount of water required divided by the amount of water delivered.
- If more water is required than delivered then the efficiency is greater than 100%.
- Example: If 2 acre-feet are required and 1 acre-foot is delivered then the Agricultural Water Use Efficiency is 200%.

Agricultural Water Use Efficiency Defined

$$\text{Water Use Efficiency} = \frac{\text{NIR} + \text{LR}}{\text{WD}} = \frac{\text{Water Required}}{\text{Water Delivered}}$$

NIR = Net Irrigation Requirement

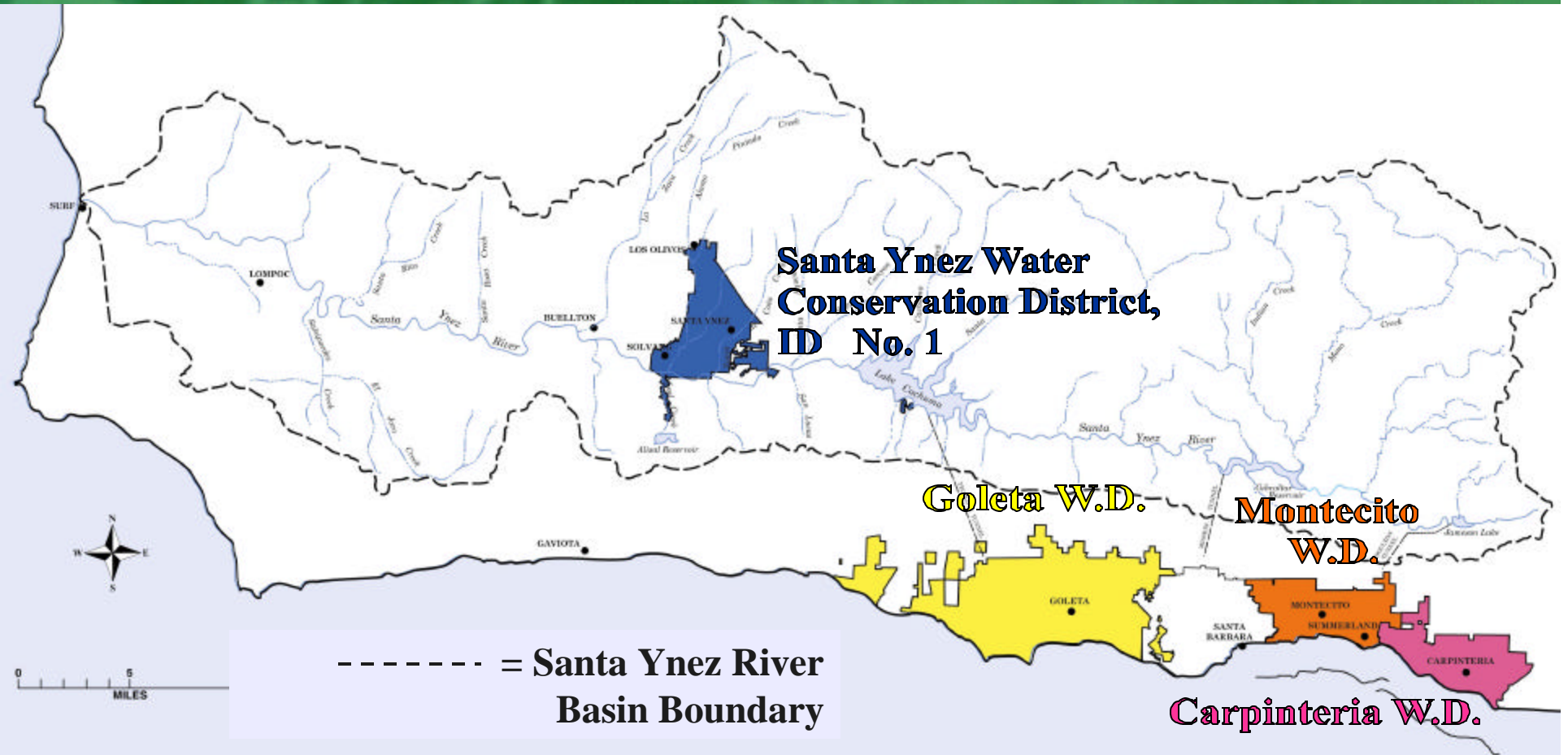
LR = Leaching Requirement

WD = Volume of Water Delivered to the Farm

Agricultural Water Use Efficiency

- Irrigated Acreage
- Cropping Pattern
- Theoretical Water Delivery Requirements
- Agriculture Water Delivery

Water Districts



Irrigated Acreage

GOLETA IRRIGATED ACREAGE

	<u>2000</u>	<u>2001</u>	<u>2002</u>
Irrigated Acreage	3,391	3,371	3,193
Irrigated Acreage Receiving only District Water	1,909	1,901	1,662

MONTECITO IRRIGATED ACREAGE

	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>
Irrigated Acreage	531	531	531	531
Irrigated Acreage Receiving only District Water	531	531	531	531

Irrigated Acreage

CARPINTERIA IRRIGATED ACREAGE

	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>	<u>1998</u>
Irrigated Acreage	3,575	3,486	3,496	3,431	3,423
Irrigated Acreage Receiving only District Water	485	511	516	507	506

ID No. 1 IRRIGATED ACREAGE

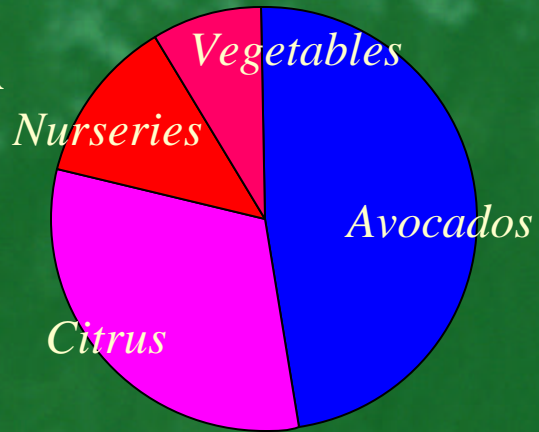
	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>
Irrigated Acreage	2,144	2,144	2,144	2,144	2,144
Irrigated Acreage Receiving only District Water	2,144	2,144	2,144	2,144	2,144

Agricultural Water Use Efficiency

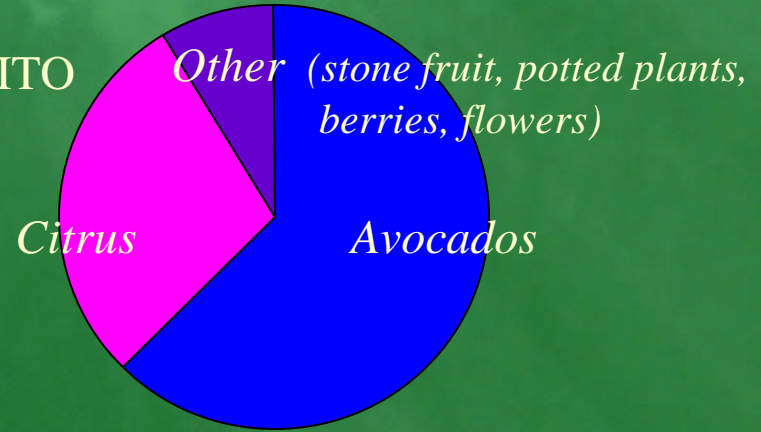
- Irrigated Acreage
- Cropping Pattern
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- Agriculture Water Delivery

Cropping Pattern

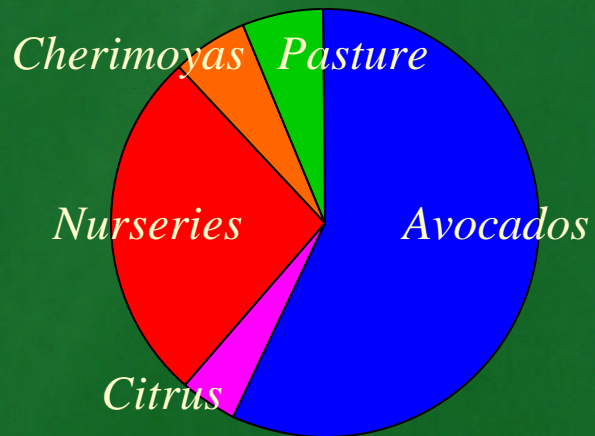
GOLETA



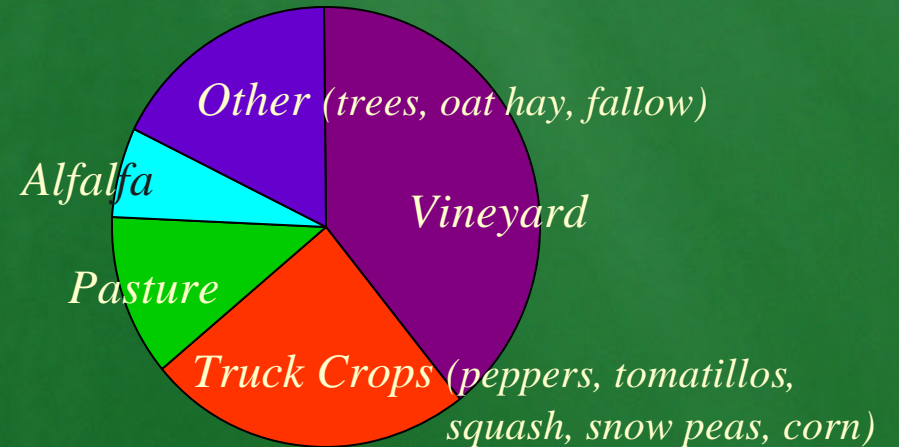
MONTECITO



CARPINTERIA



ID No. 1



Agricultural Water Use Efficiency

- Irrigated Acreage
- Cropping Pattern
- **Theoretical Water Delivery Requirements**
- Agriculture Water Delivery

Theoretical Water Delivery Requirements

Net Irrigation Requirement (NIR) + Leaching Requirement (LR)

$NIR = \text{Crop Evapotranspiration } (ET_c) - \text{Effective Precipitation } (P_e)$

$ET_c = \text{Reference Evapotranspiration } (ET_o) * \text{Crop Coefficient } (K_c)$

Theoretical Water Delivery Requirements

ANNUAL REFERENCE EVAPOTRANSPIRATION (ET₀) ON DISTRICT LANDS (Inches Per Year)

Year	Goleta	Montecito	Carpinteria	ID No. 1
1994	---*	---*	42.1	---*
1995	---*	---*	43.1	---*
1996	---*	---*	47.0	---*
1997	---*	---*	47.5	---*
1998	---*	---*	46.1	44.8
1999	---*	48.3	---*	48.1
2000	47.1	44.9	---*	47.2
2001	41.8	39.6	---*	48.9
2002	44.4	42.1	---*	52.2

**Reference evapotranspiration not calculated for the years that water delivery records were not provided by the Districts.*

Crop Evapotranspiration Defined

Crop Evapotranspiration

equals

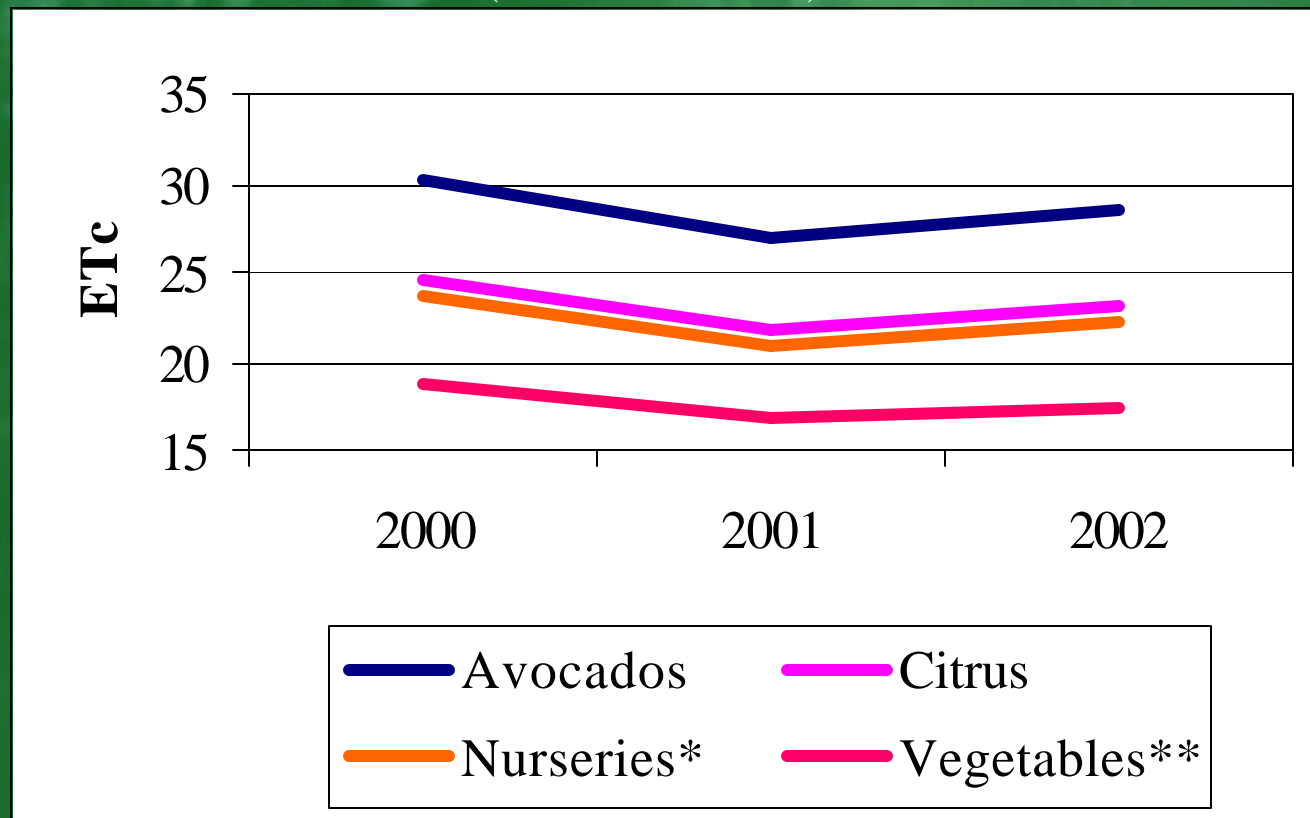
Reference Crop Evapotranspiration

times

Crop Coefficient

Theoretical Water Delivery Requirements

GOLETA ET_C
(Inches Per Year)

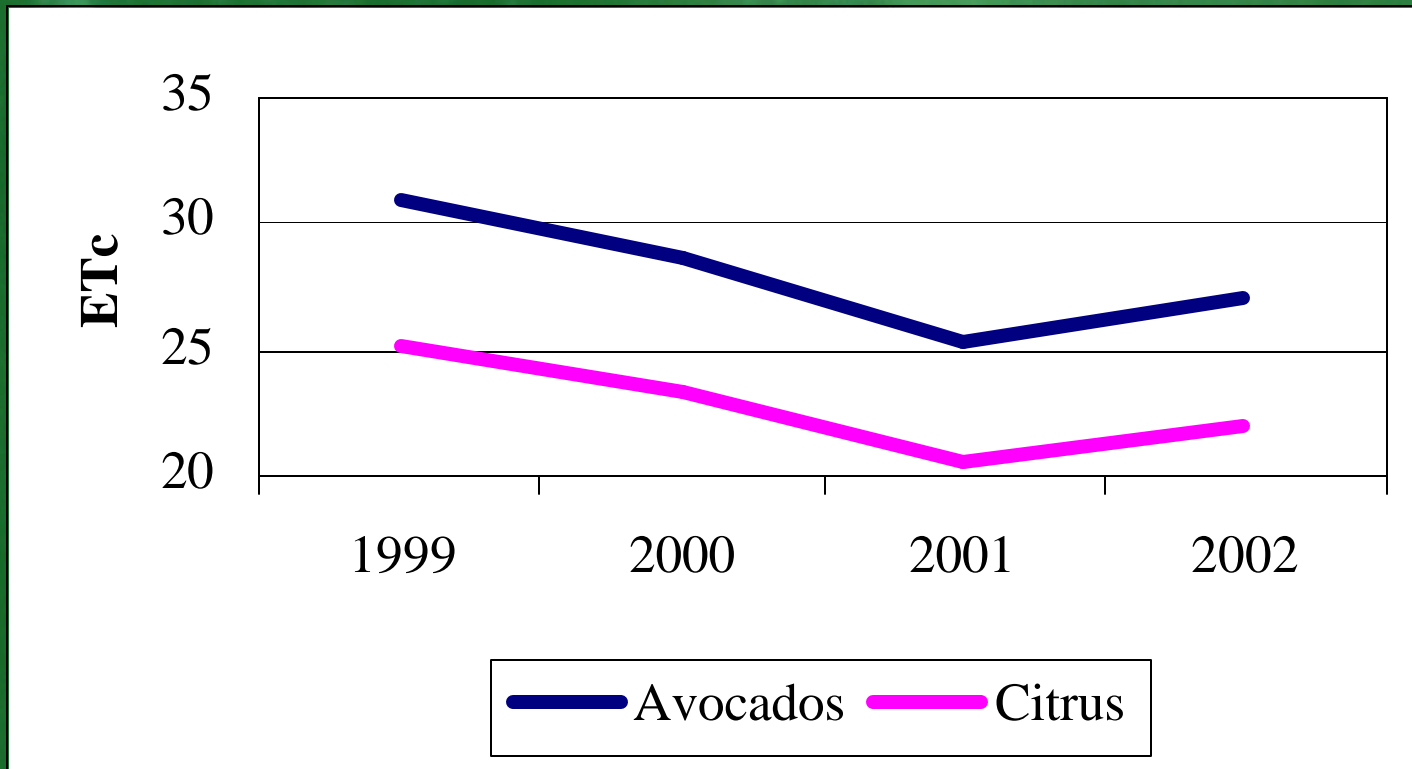


* *Outside ornamental nurseries without climate-controlled greenhouses.*

** *Vegetables include double-cropped broccoli and lettuce.*

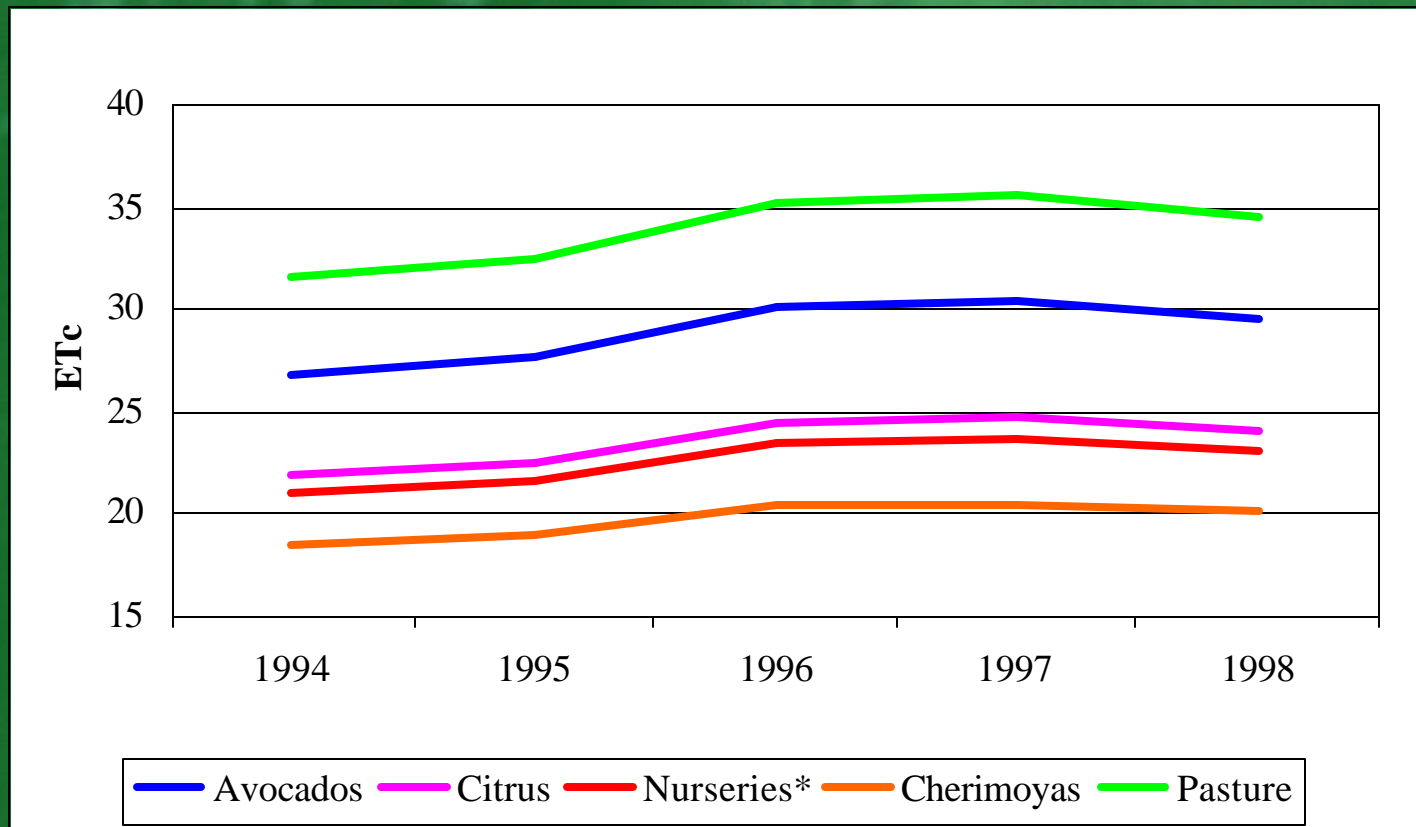
Theoretical Water Delivery Requirements

MONTECITO ET_c (Inches Per Year)



Theoretical Water Delivery Requirements

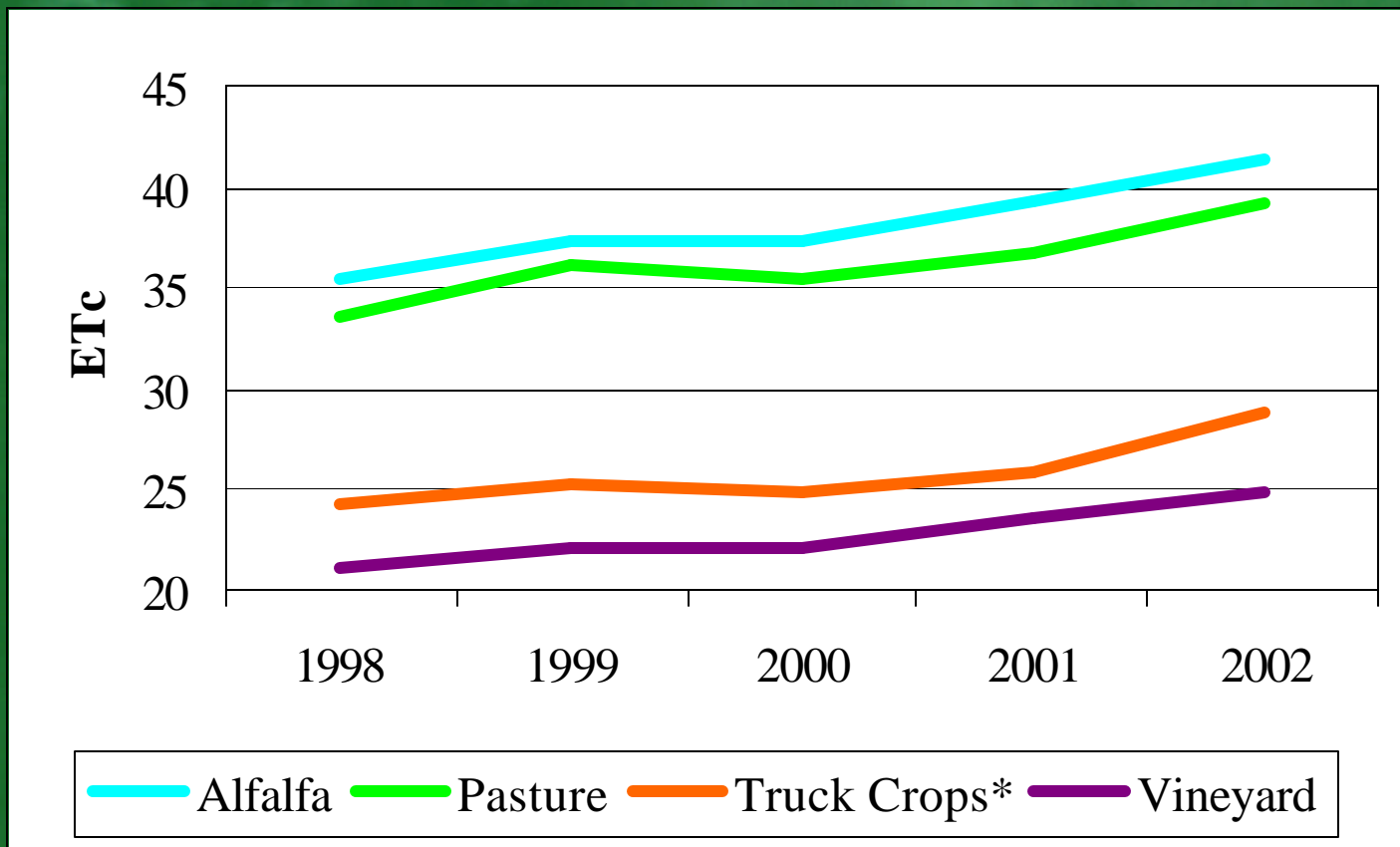
CARPINTERIA ET_c (Inches Per Year)



**Outside ornamental nurseries without climate-controlled greenhouses*

Theoretical Water Delivery Requirements

ID No. 1 ET_C
(Inches Per Year)



* *Truck crops include double-cropped peppers and snowpeas.*

Net Irrigation Requirements Defined

Crop Evapotranspiration

minus

Effective Precipitation

Theoretical Water Delivery Requirements

GOLETA NIR (Inches Per Year)

<u>Year</u>	<u>Avocados</u>	<u>Citrus</u>	<u>Nurseries</u>	<u>Vegetables</u>
2000	22.6	17.1	17.5	12.9
2001	14.9	10.5	12.2	7.0
2002	23.7	18.3	17.4	12.5

Theoretical Water Delivery Requirements

MONTECITO NIR (Inches Per Year)

<u>Year</u>	<u>Avocados</u>	<u>Citrus</u>
1999	25.5	19.8
2000	18.2	12.5
2001	14.7	9.9
2002	22.1	17.1

Theoretical Water Delivery Requirements

CARPINTERIA NIR (Inches Per Year)

<u>Year</u>	<u>Avocados</u>	<u>Citrus</u>	<u>Nurseries</u>	<u>Cherimoyas</u>	<u>Pasture</u>
1994	21.0	16.1	15.2	12.8	23.0
1995	18.6	12.9	14.5	8.5	20.5
1996	21.7	16.2	15.6	12.4	23.1
1997	23.8	18.3	18.6	14.2	26.9
1998	18.6	12.2	13.6	7.5	19.3

Theoretical Water Delivery Requirements

ID No. 1 NIR (Inches Per Year)

<u>Year</u>	<u>Alfalfa</u>	<u>Pasture</u>	<u>Truck Crops</u>	<u>Vineyard</u>
1998	25.0	22.6	17.0	11.1
1999	29.5	30.2	20.1	15.1
2000	23.7	23.4	16.4	9.7
2001	18.1	15.9	14.3	7.1
2002	33.2	32.3	22.4	16.1

Types of Irrigation Systems

- Micro Sprinkler
- Drip
- Sprinkler

Micro Sprinkler



Drip Irrigation - Vineyard



Drip Irrigation



Theoretical Water Delivery Requirement

Theoretical Water Delivery Requirement

equals

the Net Irrigation Requirement

plus

the **Leaching Requirement**

Theoretical Water Delivery Requirements

LEACHING PERCENTAGE FOR **DRIP** IRRIGATION

<u>Crop</u>	<u>Goleta</u>	<u>Montecito</u>	<u>Carpinteria</u>	<u>ID No. 1</u>
Avocados	6%	5%	6%	---
Cherimoyas	---	---	5%	---
Citrus	4%	4%	5%	---
Nurseries	2%	---	2%	---
Truck Crops	---	---	---	4%
Vegetables	1%	---	---	---
Vineyard	---	---	---	3%

Theoretical Water Delivery Requirements

LEACHING PERCENTAGE FOR **SPRINKLER** IRRIGATION

<u>Crop</u>	<u>Goleta</u>	<u>Montecito</u>	<u>Carpinteria</u>	<u>ID No. 1</u>
Alfalfa	---	---	---	9%
Avocados	14%	12%	15%	---
Cherimoyas	---	---	10%	---
Citrus	10%	9%	11%	---
Nurseries	8%	---	9%	---
Pasture	---	---	9%	9%
Truck Crops	---	---	---	13%
Vegetables	9%	---	---	---
Vineyard	---	---	---	13%

Theoretical Water Delivery Requirements

UNIT THEORETICAL WATER DELIVERY REQUIREMENTS (Acre-Feet Per Acre)

<u>Year</u>	<u>Goleta</u>	<u>Montecito</u>	<u>Carpinteria</u>	<u>ID No. 1</u>
1994	---	---	1.94	---
1995	---	---	1.74	---
1996	---	---	1.97	---
1997	---	---	2.18	---
1998	---	---	1.72	1.44
1999	---	2.23	---	1.80
2000	1.88	1.60	---	1.37
2001	1.27	1.30	---	1.10
2002	1.92	1.93	---	1.97
Average	1.69	1.76	1.91	1.54

Theoretical Water Delivery Requirements

<u>Year</u>	Acre-Feet			
	<u>Goleta</u>	<u>Montecito</u>	<u>Carpinteria</u>	<u>ID No. 1</u>
1994	---	---	942	---
1995	---	---	889	---
1996	---	---	1,016	---
1997	---	---	1,104	---
1998	---	---	872	2,028
1999	---	1,083	---	2,543
2000	3,585	778	---	1,937
2001	2,423	634	---	1,545
2002	3,190	938	---	2,771
Average	3,066	858	965	2,164

Agricultural Water Use Efficiency

- Irrigated Acreage
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Agricultural Water Delivery

UNIT AGRICULTURAL WATER DELIVERY

(Acre-Feet Per Acre)

<u>Year</u>	<u>Goleta</u>	<u>Montecito</u>	<u>Carpinteria</u>	<u>ID No. 1</u>
1994	---	---	0.64	---
1995	---	---	0.56	---
1996	---	---	0.62	---
1997	---	---	0.89	---
1998	---	---	0.61	0.86
1999	---	0.86	---	1.07
2000	0.75	0.71	---	0.91
2001	0.67	0.45	---	0.98
2002	1.07	0.86	---	1.01
Average	0.83	0.72	0.66	0.97

Agricultural Water Delivery

<u>Year</u>	Acre-Feet			
	<u>Goleta</u>	<u>Montecito</u>	<u>Carpinteria</u>	<u>ID No. 1</u>
1994	---	---	310	---
1995	---	---	285	---
1996	---	---	320	---
1997	---	---	452	---
1998	---	---	309	1,208
1999	---	419	---	1,510
2000	1,437	345	---	1,288
2001	1,267	218	---	1,374
2002	1,793	418	---	1,417
Average	1,499	350	335	1,359

Agricultural Water Use

District	Average Unit Water Requirements AFA	Average Unit Water Delivery AFA
Goleta	1.69	0.83
Montecito	1.76	0.72
Carpinteria	1.91	0.66
ID No. 1	1.54	0.97

Agriculture Water Use Efficiency

<u>District</u>	<u>Average Irrigated Acreage</u>	<u>Average Irrigated Acreage for Efficiency</u>	<u>Average Efficiency</u>
Goleta	3,318	1,824	204%
Montecito	531	486	250%
Carpinteria	3,481	505	288%
ID No. 1	2,144	1,409	159%

Agriculture Water Use Efficiency

- How can the efficiency be greater than 100%?
- Water Delivered is less than the Water Required.
- Because of the high cost of water and metered delivery, it appears that on average, the farmers conserve water.

Conclusion

The agricultural watering practices within the four water Districts located in the Cachuma project service area mainly rely on drip, micro-sprinkler, and sprinkler irrigation systems. These types of irrigation systems are among the most efficient methods used for irrigation in California. By 2020, the California Department of Water Resources assumes that the on-farm efficiency in the state of California will average 73 percent, which is considerably lower than the average efficiency of the four Districts located in the Cachuma project service area.

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