# Hydroeconomic Modeling of Perennial Crop Dynamics and GSP Demand Management Under SGMA

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# Topics

1. Demand management
2. Hydroeconomic modeling
3. Permanent crops and economic impacts under SGMA

# DEMAND MANAGEMENT

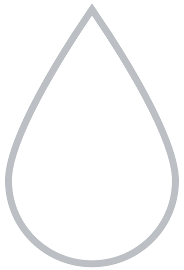
# What is demand management?

## Demand Management

- Programs that reduce net groundwater pumping (pumping net of recharge), or alternatively, net depletion.

## Implementation

- Allocations
- Other incentives
- Water trading is not, by itself, a demand management program



## Program interest

- GSP implementation
- Supply augmentation and sustainability through demand management

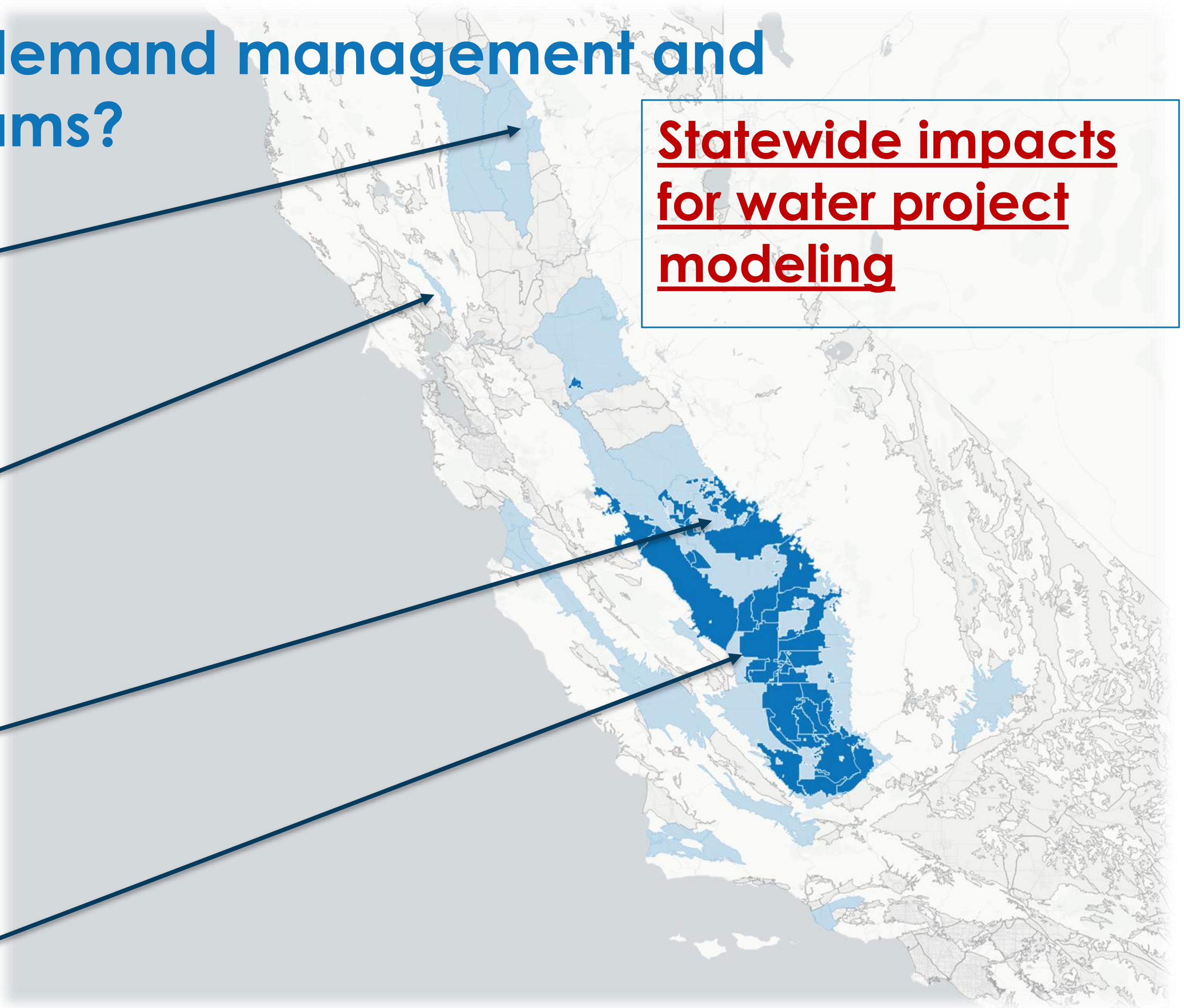
# GSP Implementation

- Initial focus is on projects (e.g., recharge) to augment supplies
- Demand management planned in some areas and may become reality in others

| GSP Implementation | GSP Estimated Average Annual Yield (TAF/Y) | GSP Estimated Capital Cost ($Millions) |
|---|---|---|
| Demand Management | 480 (22%) | $185 |
| Supply Expansion | 1,675 (78%) | $3,680 |
| Total | 2,150 | $3,860 |

Central Valley Subbasins using raw GSP data

# Who is considering demand management and what types of programs?



**Statewide impacts for water project modeling**

**Vina Subbasin**
Extend Orchard Replacement Program

**Napa Valley Subbasin**
Groundwater Pumping Reduction and Water Conservation Workplans

**Madera County GSA**
Allocations, Voluntary Land Repurposing, LandFlex, Multibenefit Land Repurposing

**MAGSA**
Fees, water measurement, potential water market

# HYDROECONOMIC MODELING

# Why do we need hydroeconomic modeling?

## Physical conditions

What is the problem?

Defined in:

- GSP water balances
- Statute, regulations, policy

## Project considerations

Projects and management actions (GSP)

Project feasibility / impact analyses (e.g., LTO, CASP)

## Implementation

Project benefits and feasibility determinations

How much demand management vs supply augmentation?

Demand management program design

# SWAP Model: A Brief History

## CVPM

Production function: water – irrigation technology isoquant

PMP calibration: linear marginal cost

## SWAP 6

Production function: CES, constant returns to scale

PMP calibration: exponential

Supply response: elasticity tradeoff

## SWAP 6.1

Data update to SWAP 6; Code and calibration changes

## SWAP-RTS

Production function: CES, decreasing returns to scale

PMP calibration: DRS

Supply response: calibration to elasticities

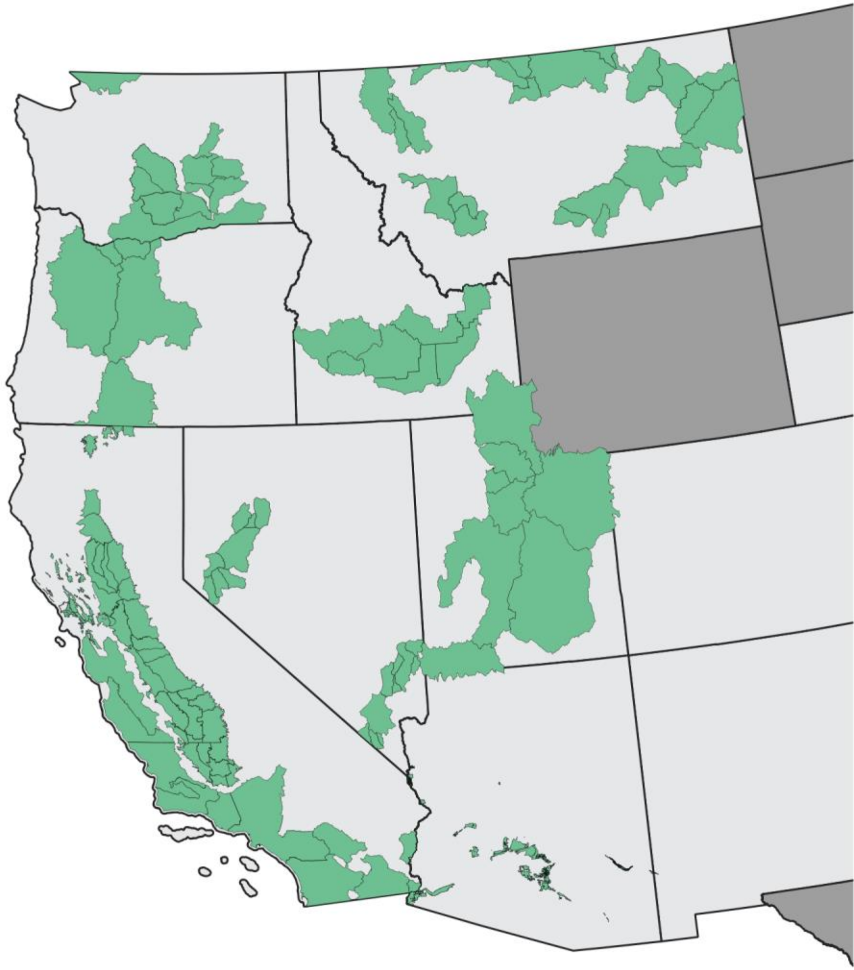
Permanent crop dynamics

Geospatial data calibration

Improved crop market linkage for agricultural modeling

# Current Modeling Framework

- Economics integrated with biophysical parameters
  - Calsim 2 and 3, C2VSim, SVSim, local groundwater models, water balances, GSA data
  - Hydroeconomics
- – Calibration under SWAP-RTS
  - To current conditions and response
  - Crop markets (e.g., dairy)
  - Crop dynamics





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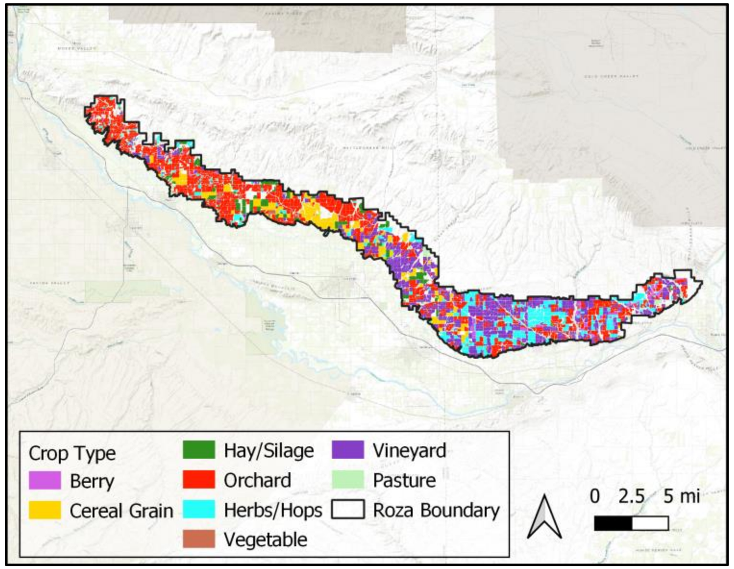
# Field Level RTS Framework

- Why field level?
  - Geospatial data availability
  - Permanent plantings
  - Spatial detail for hydroeconomic evaluation
    - SGMA, water trading
- Example: Roza Irrigation District (Yakima)
  - Decreasing returns to scale CES production function for each crop and region
  - Field aggregated continuous production functions and water supply functions
  - Discrete field-level model with differing water use, cost, and production for regional and field-specific outcomes

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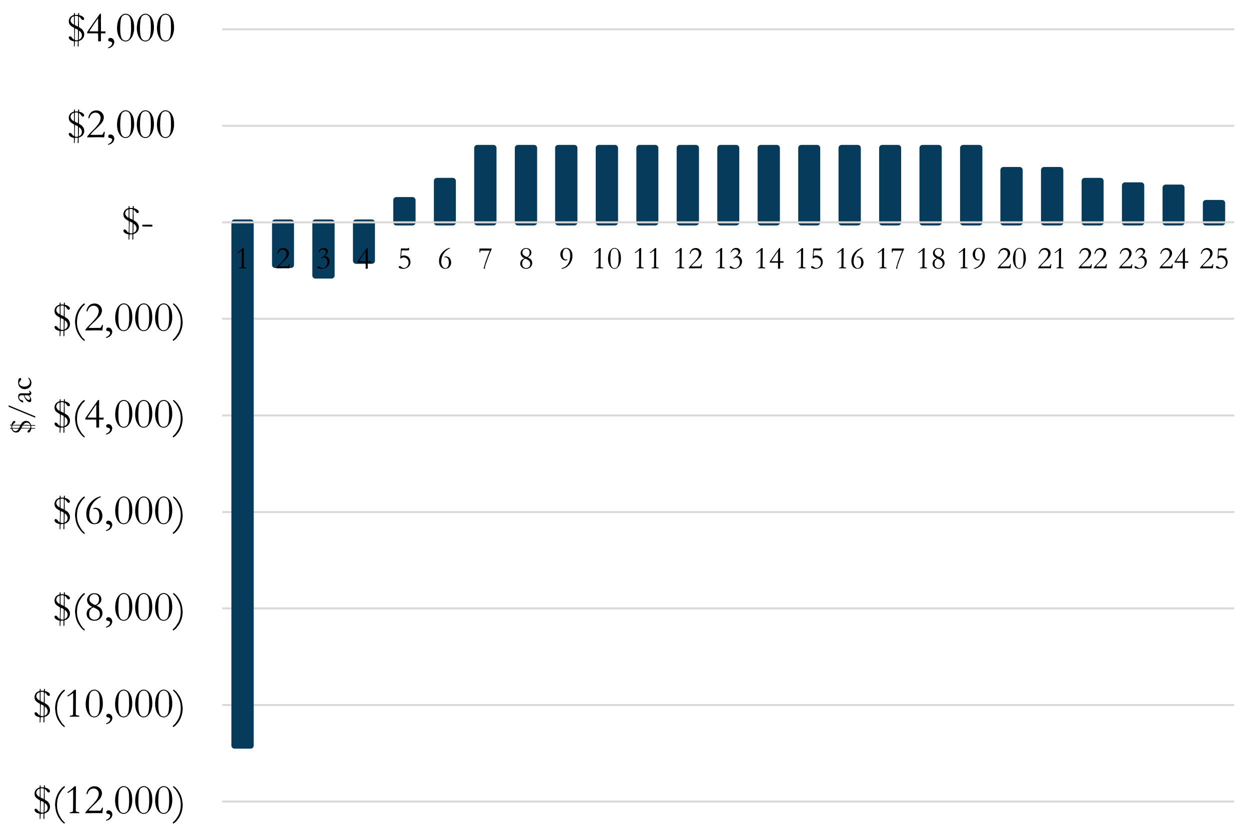
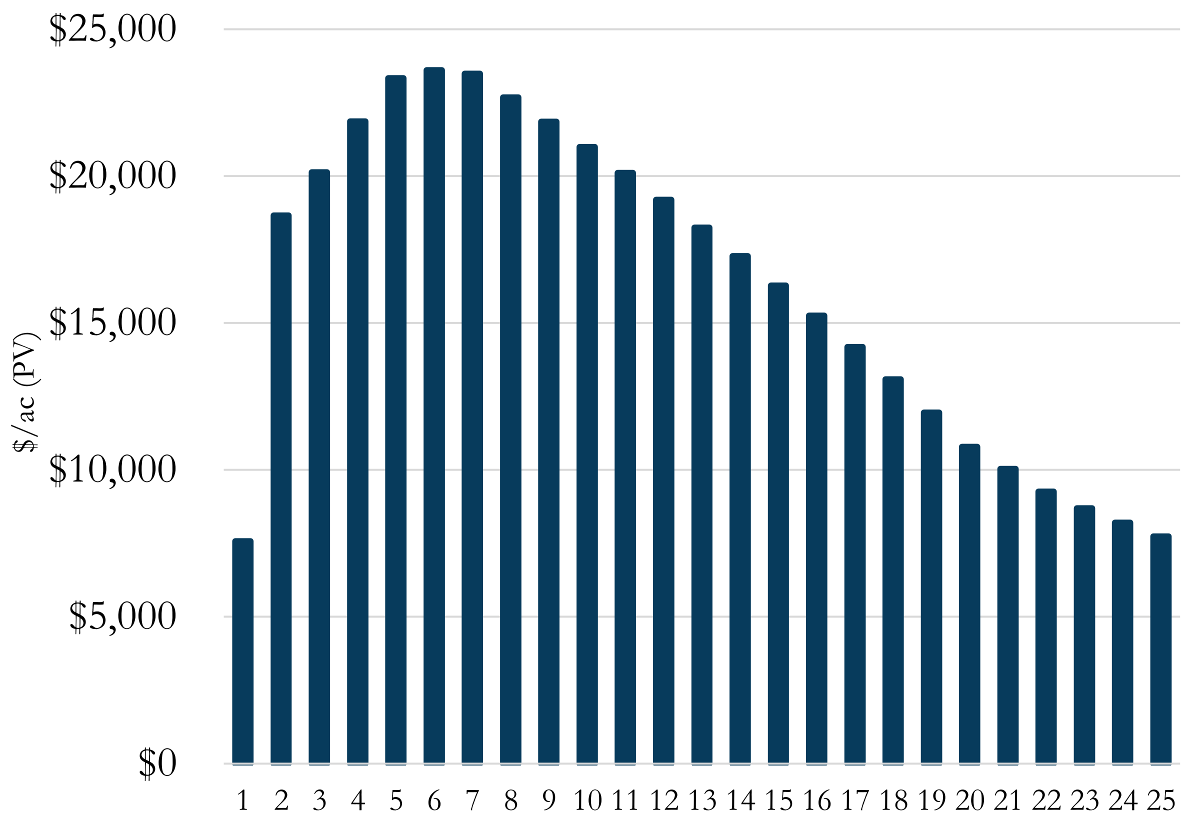
# CALIFORNIA EXAMPLE: PERMANENT CROPS & SGMA IMPACTS

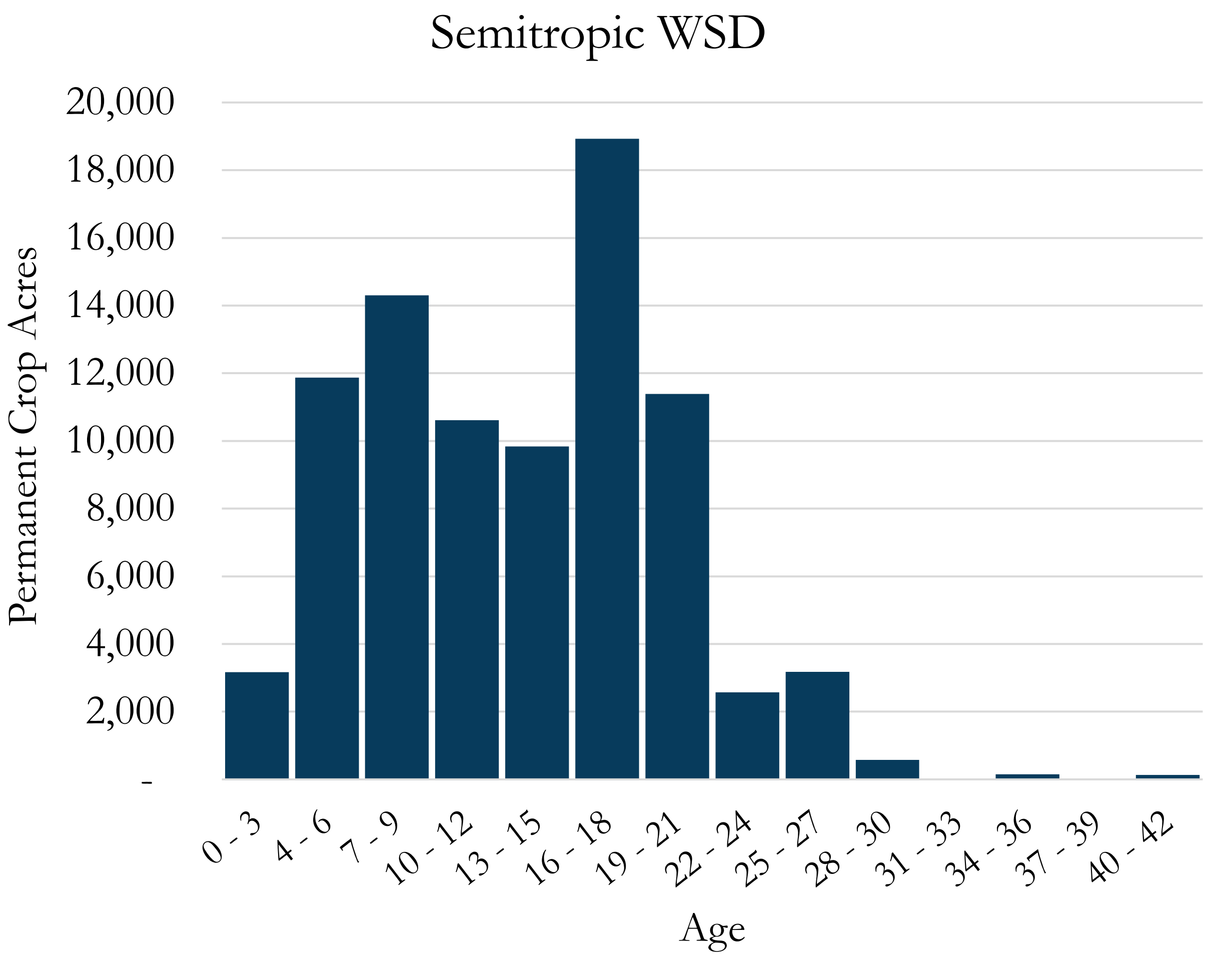
# Permanent Crop Dynamics

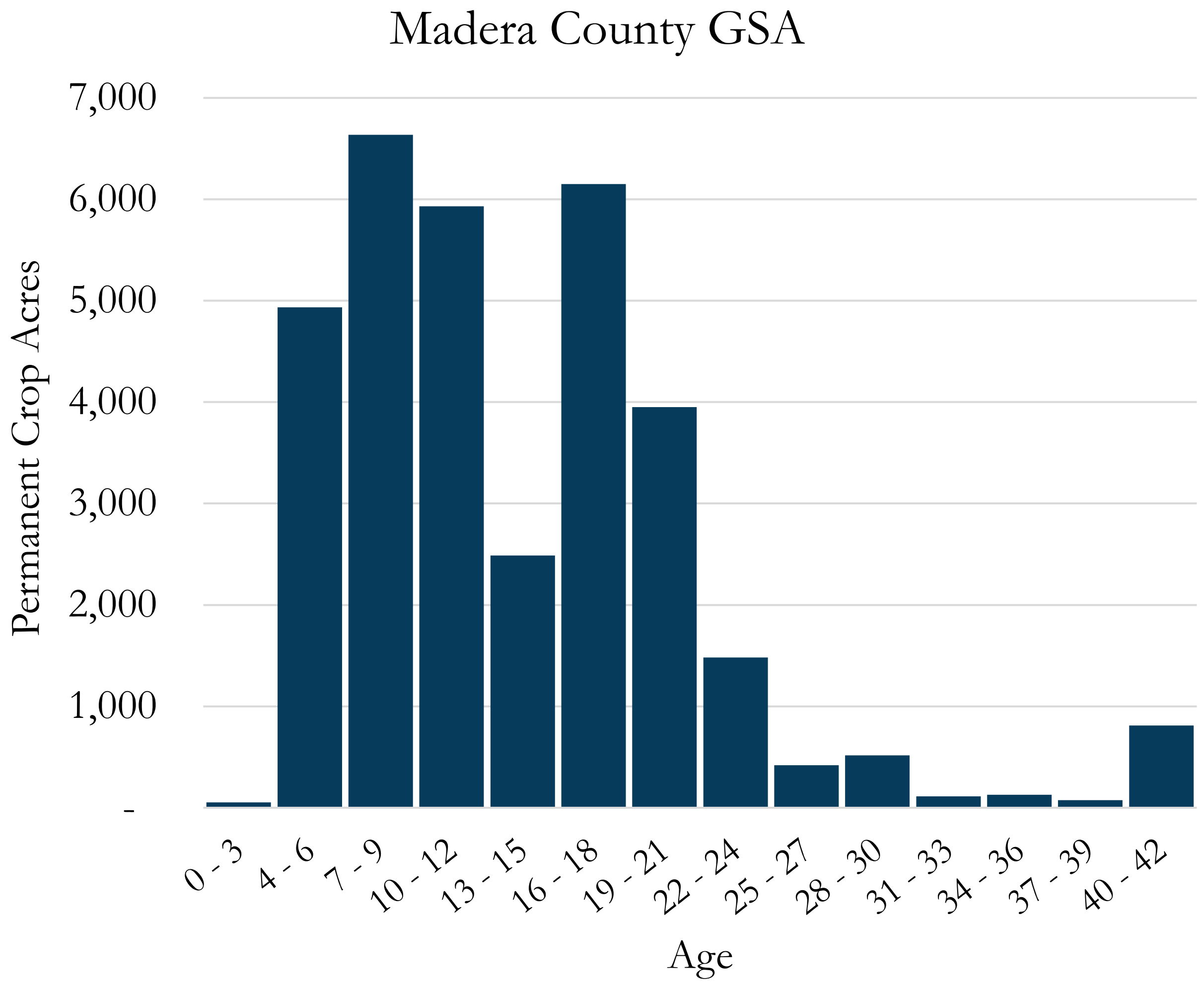
- Permanent crops are a capital asset



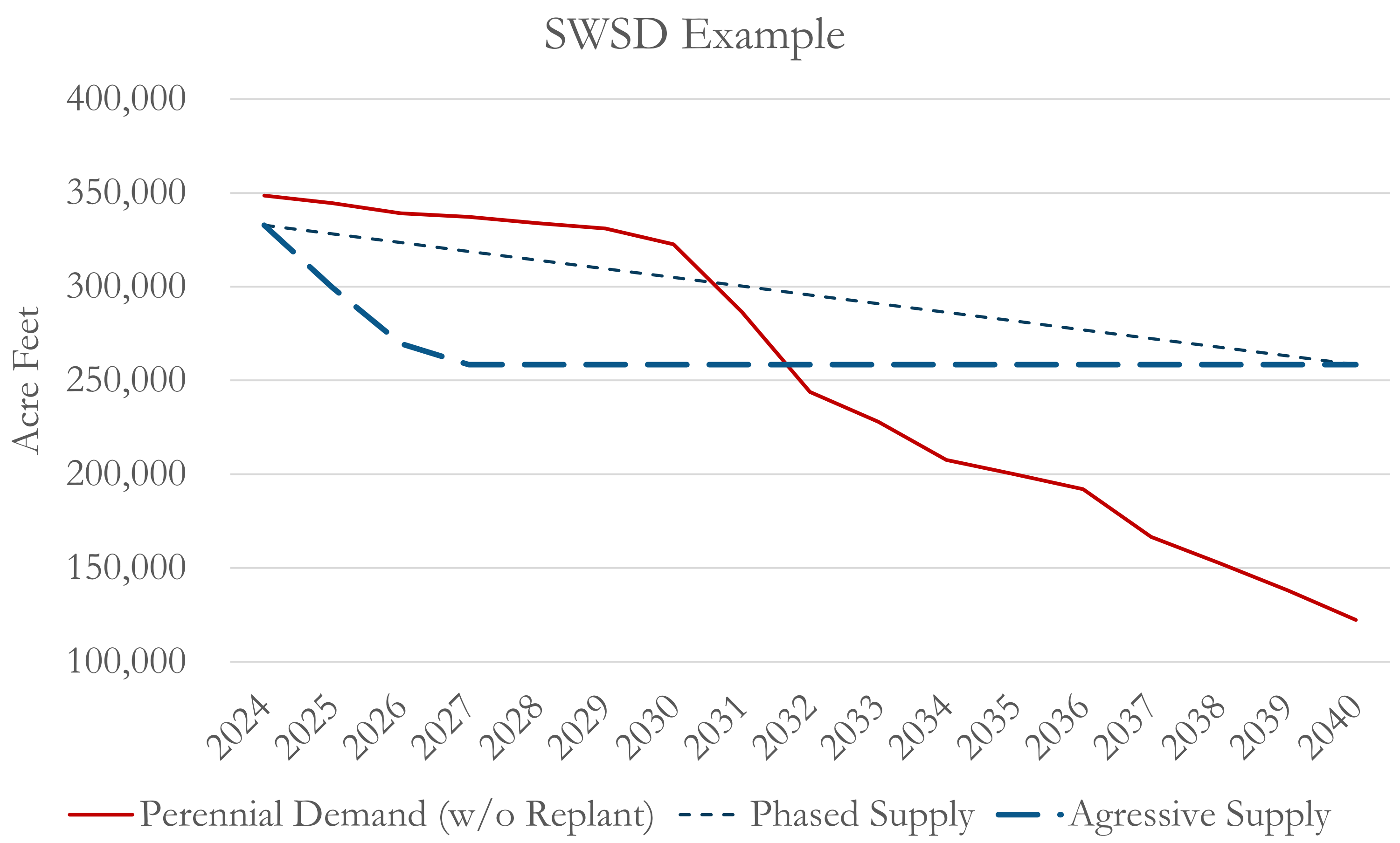



# Age Distribution of Current Plantings



# SWSD Example




Example: permanent crops only (almond proxy) under hypothetical fixed/flat allocation

- NPV loss in gross returns
  - $26.3 M, phased
  - $35.9 M, aggressive
  - $9.7 million present value savings



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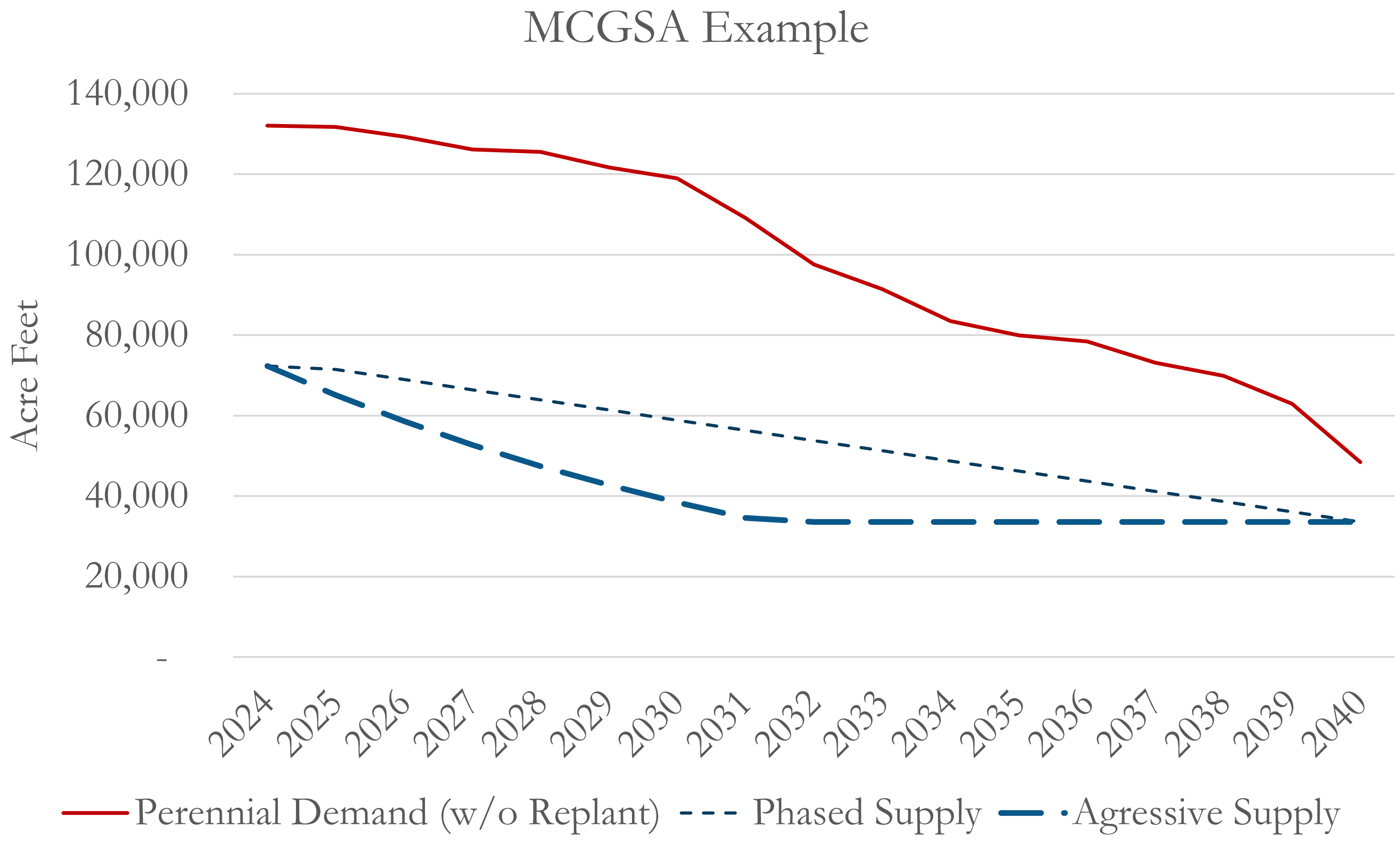
# MCGSA Example




- NPV loss in gross returns
  - $64.5 M, phased
  - $98.7 M, aggressive
  - $34.2 million present value savings

Example: permanent crops only (almond proxy) under hypothetical fixed/flat allocation

# Summary

Hydroeconomic modeling

- Supports GSP program development
- Integrated with state and federal water project evaluation

- Economic impacts
  - Gradual implementation allows time to recoup capital investments
  - Lessen impacts for local communities
  - Substantial implications for state and federal projects and CALSIM integration

# THANK YOU

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