# This meeting will start at 2pm

Please ensure you have the latest version of Zoom

December 3, 2021

CALIFORNIA Water Boards

# Public Workshop to Support the Development of Efficiency Standards

## Methods used to evaluate efficiency standards' effects on parklands and urban tree health

December 3, 2021

CALIFORNIA Water Boards

Office of Research, Planning, and Performance

# Please introduce yourself via chat

- What's your name?
- What group or organization are you representing?
  - Example: Karina Herrera - State Water Resources Control Board

Max Gomberg

Mary Yang

**Paola Gonzalez, presenter**

Marielle Rhodeiro

Chris Martinez

Office of Research

Planning and Performance

# Climate & Conservation Team

Beti Girma

Chris Hyun

**Charlotte Ely**

**Karina Herrera, presenter**

Bethany Robinson

# Welcome and Introductions

- **Erik Porse, PhD,** OWP at Sacramento State | UCLA
- **Joanna Solins**, PhD, UC Davis
- **Julia Skrovan**, UCLA California Center for Sustainable Communities
- **Robert Cudd**, UCLA California Center for Sustainable Communities

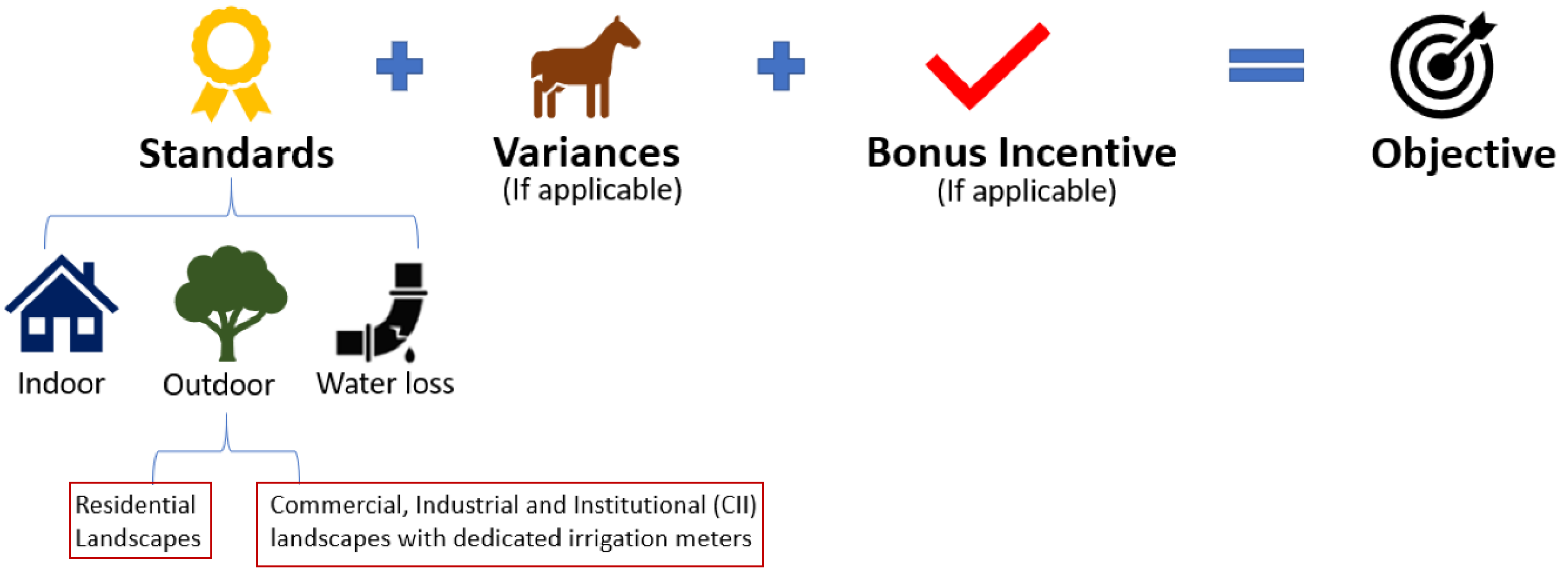
# Agenda

- Background
  - Legislation
  - Outdoor standards
  - 10609.2 requirements
- **Methods used** to evaluate efficiency standards' effects on parklands and urban tree health
- Short Break
- Planned schedule
- Q&A
- Next steps

# Legislation Background

- 2018 conservation legislation:
  - Senate Bill (SB) 606 (Hertzberg)
  - Assembly Bill (AB) 1668 (Friedman).
- Established a new water use efficiency framework
- Major actions:
  - DWR provides recommendations (2021)
  - State Water Board conducts rulemaking (2022)
  - Urban Retail Water Suppliers calculate "objectives" (2024)

# Urban Water Use Objective



# Overview of SB 606/AB 1668: outdoor use

- Outdoor Standards
  - Residential outdoor standard
    - An Evapotranspiration factor (ETF) that declines overtime
  - Standard for CII landscapes with Dedicated Irrigation Meters (DIM)
    - An ETF that declines overtime
    - An ETF that's 100% of ETO for Special Landscape Areas
- CII Performance Measures
  - Minimum size threshold for adding a DIM or in-lieu technology
  - Best Management Practices for those CII customers exceeding that threshold.

# Background on Outdoor Standards

The outdoor standards shall incorporate the principles of the model water efficient landscape ordinace (MWELO).

$$ORWU = (ETo - Peff)*0.62*ETF*LAs$$

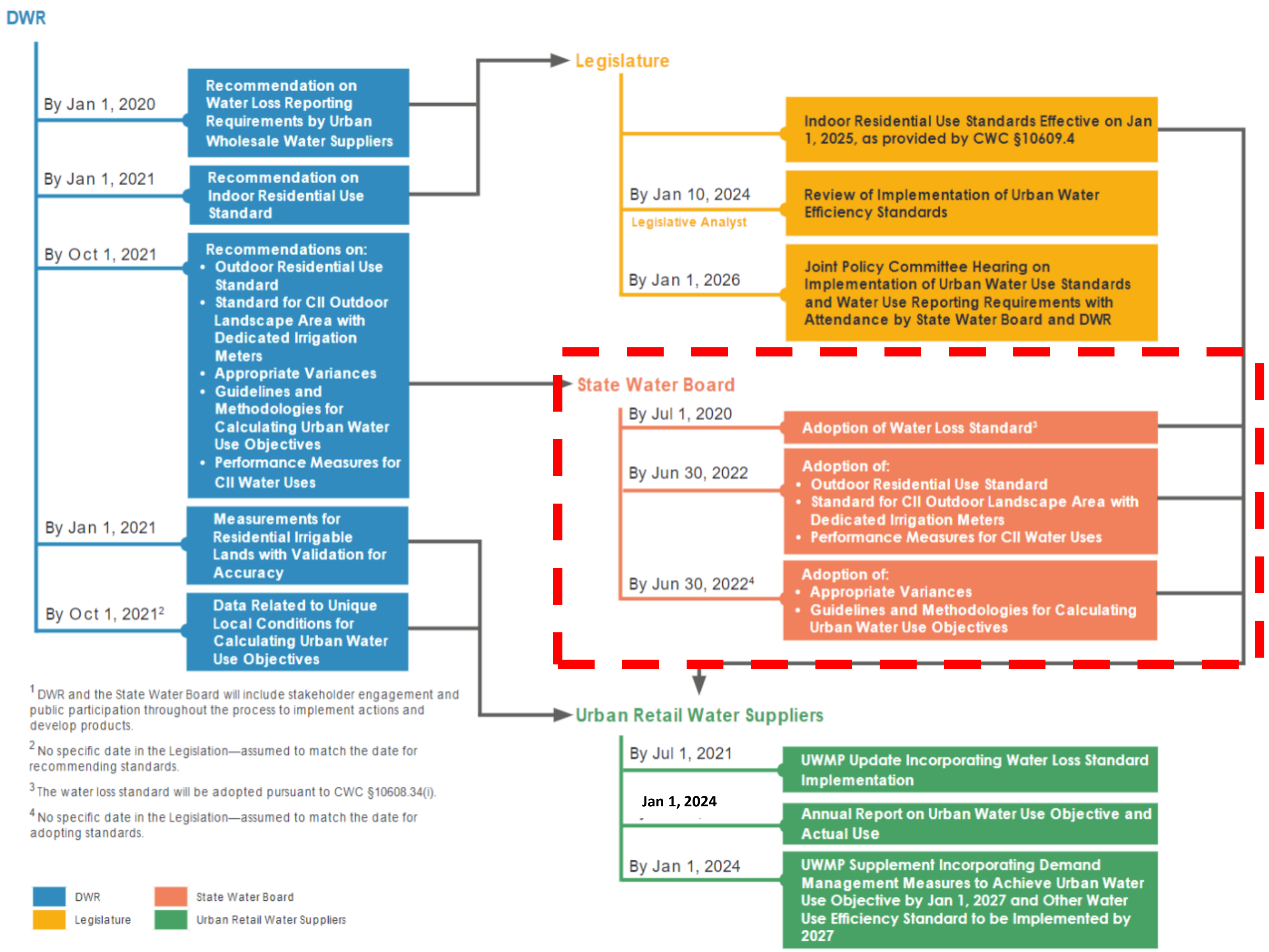
- ORWU = Outdoor Residential Water Use (gallons)
- ETo = Reference Evapotranspiration (inches)
- Peff = Effective precipitation (inches)
- ETF = Supplier level ET factor (unitless) (the standard)
- LAs = Landscape area for a water supplier (sq. ft.)
- 0.62 - unit conversion factor

# Wastewater, parklands, and trees

CWC Section 10609.2(c)

- (c) When adopting the standards under this section, the board shall consider the policies of this chapter and the proposed efficiency standards’ ***effects on local wastewater management, developed and natural parklands, and urban tree health***. The standards and potential effects shall be identified by May 30, 2022. The board shall allow for public comment on potential effects identified by the board under this subdivision.

# How does 10609.2(c) fit into the overall process?



# How does 10609.2(c) fit into the overall process?

State Water Board

| | |
|---|---|
| **TBD** | Adoption of water loss standards |
| **By May 30, 2022** | Identify impacts on local wastewater management, parklands, and urban tree health. |
| **TBD** | Adoption of water loss standards<br>• Outdoor Residential Use Standard<br>• Standard for CII outdoor landscapes with dedicated irrigation meters<br>• Performance Measures for CII water uses<br>• Appropriate variances<br>• Guidelines and methodologies for calculating urban water use objectives |

# Evaluating the impact of the new framework on urban trees and parklands

- Trees
  - What tree species are here?
  - How much water do they use?
  - Where might changes in water use affect urban tree health?
- Parklands
  - What parklands might be affected?
  - What resources do park managers have to increase water use efficiency?

# Poll (please answer on chat):

In under 10 words, describe your vision for water efficient and climate resilient landscapes in your community

# Our team's vision for the future

- Using less water to create and maintain healthy urban landscapes now and in the future
- Expand the urban forest

Image from sfpublicworks.org

# Why water efficiency matters

- Water savings
- Energy savings
- Reduced water bills
- Protects water quality
- Implementing efficiency standards equitably
- Requires cross-sector partnerships

# Economic and Environmental Effects of AB 1668-SB 606

## Effects on urban trees and parklands

December 3, 2021


**Erik Porse, PhD,** OWP at Sacramento State | UCLA
**Joanna Solins, PhD,** UC Davis
**Julia Skrovan**, UCLA California Center for Sustainable Communities
**Robert Cudd**, UCLA California Center for Sustainable Communities





WATER PROGRAMS Sacramento State
UCLA Institute of the Environment and Sustainability

# Full Project Scope

Key sectors:

- Urban Retail Water Suppliers: costs & benefits, low-income communities
- Wastewater: conveyance, treatment, and reuse
  - Odor & corrosion, water quality, recycled water production potential
- Developed and natural parklands within service areas
  - Effects of irrigation regimes on vegetation
- Urban trees
  - Risks for urban trees associated with changes in outdoor water use

# Full Project Team

## Expertise in urban water supply, wastewater management, urban ecology, and economics related to AB 1668-SB 606

**Water Programs, Sacramento State**

Erik Porse, PhD
Jonathan Kaplan, PhD
Maureen Kerner, PE
John Johnston, PhD, PE
Harold Leverenz, PhD, PE
Caitlyn Leo
Khalil Lezzaik, PhD
Dakota Keene
David Babchanik
Patrick Maloney
Scott Meyer
Samira Moradi
Ramzi Mahmood, PhD

**UCLA Institute of the Environment and Sustainability**

Stephanie Pincetl, PhD
Lawren Sack, PhD
Felicia Federico, PhD
Robert Cudd
Julia Skrovan
Hannah Gustafson
Marvin Browne
Lauren Strug

**The University of California, Davis**

Mary Cadenasso, PhD
Joanna Solins, PhD
Bogumila Backiel

**Humboldt State University**

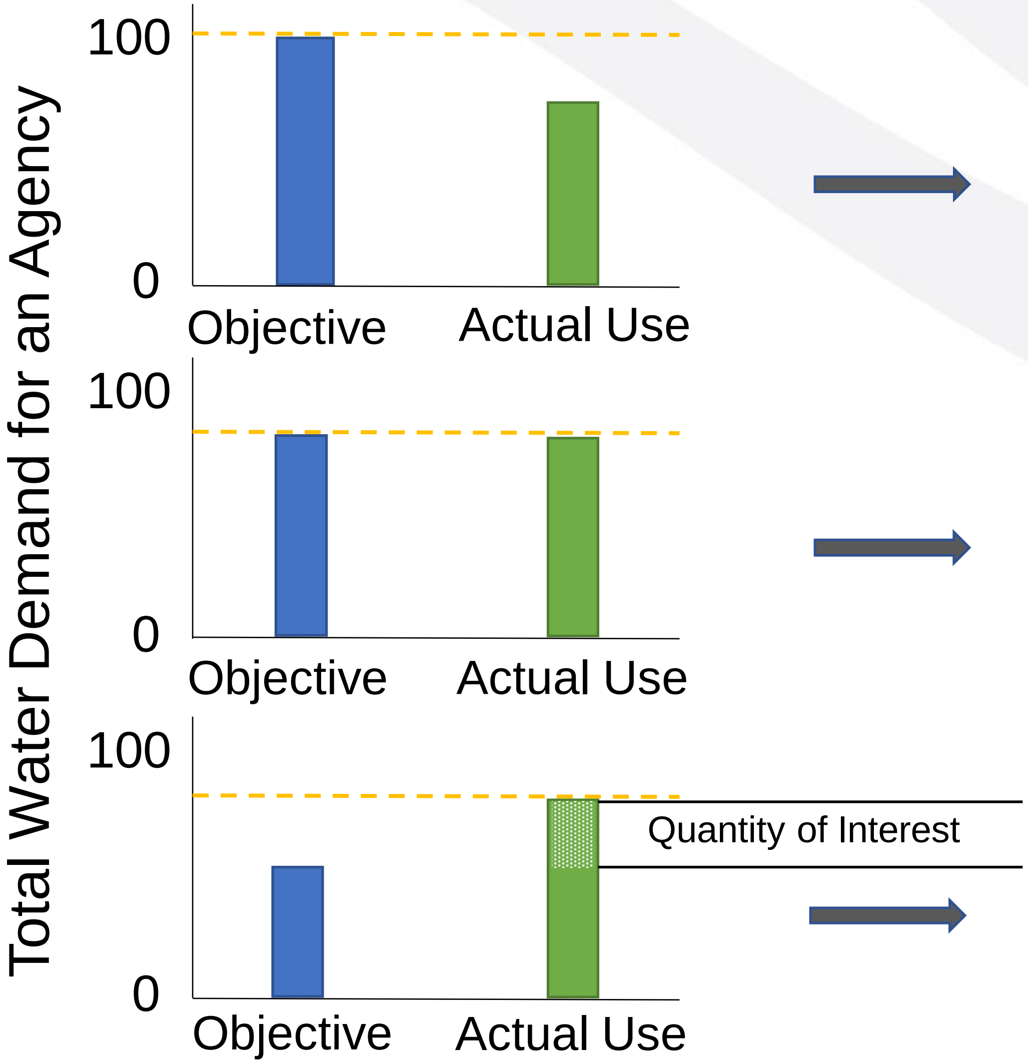
Erick Eschker, PhD
Jonathan Sander

# Overall Evaluation Approach

1) Calculate scenarios of objectives based on parameters provided by state agencies
2) Evaluate current and future water demand
3) Evaluate Suppliers that will need reductions
4) Project likely compliance actions and effects
5) Assess effects “downstream” for wastewater management & landscapes

Source: circleofblue.org

# Assessing Effects: Comparing Objectives and Actual Use

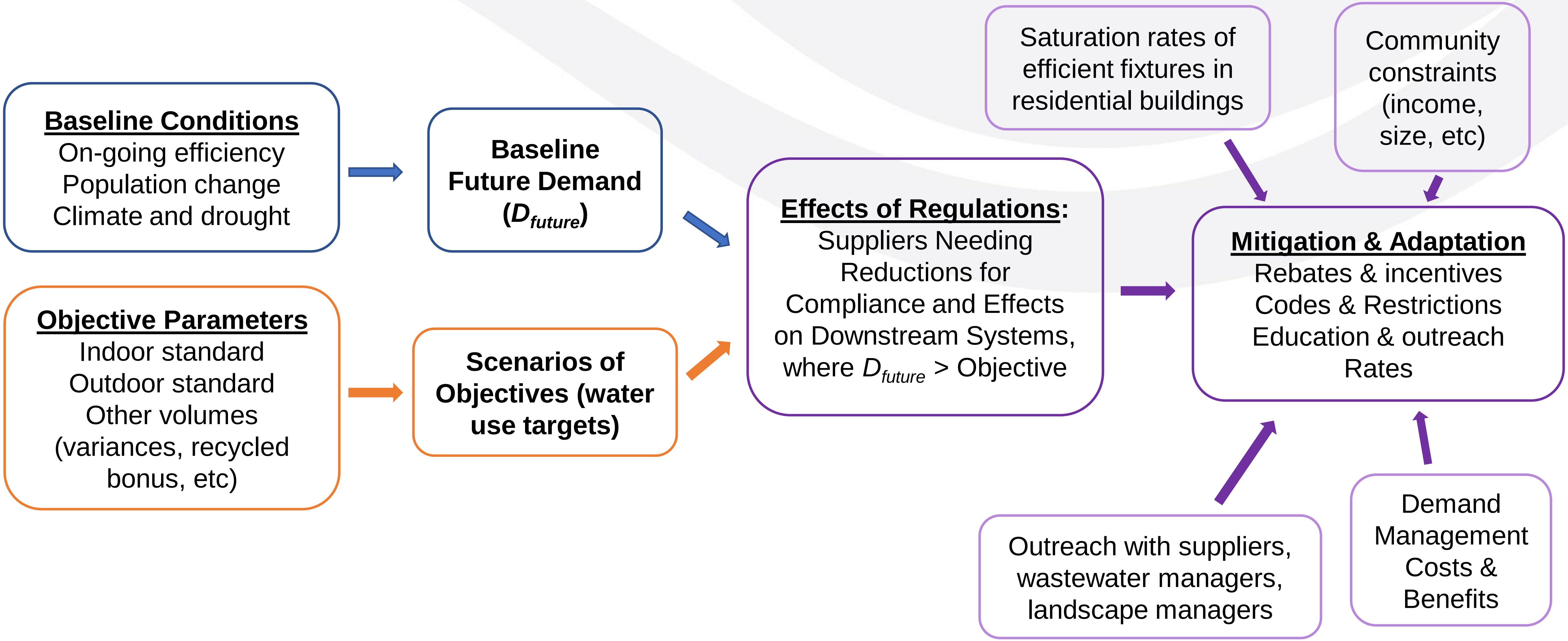



No new economic and environmental effects

Limited/no new economic and environmental effects

Assess effects based on likely mitigation actions for compliance

# Evaluating Mitigation and Adaptation Actions



# Evaluating effects on residential urban trees

Approach:

1) Estimate water demand of urban vegetation in residential areas
   a) Define residential areas
   b) Calculate tree canopy and turf area
   c) Evaluate tree species & size distributions
   d) Calculate water demand using equations from field studies

2) Compare vegetation water demand to current water use and predicted changes under objectives scenarios

3) Evaluate risks to trees for each Supplier

# Methods for calculating vegetation water demand

- MWELO
  - New landscapes, set standards
- Top-down: Remote sensing
  - ECOSTRESS, BESS
  - Pilot: Not accurate enough for urban
- Bottom-up: Plant transpiration
  - Pilot: Robust results
  - Considerable data requirements

# Calculating Residential Vegetation Water Demand: Bottom-up method

**Trees**:

- Type of tree (broadleaf, conifer, palm)
- Planting density (total # trees)
- Sapwood area (tree size)
- Vapor pressure deficit & solar radiation

**Turf**:

- Total turf area
- Proportion shaded
- Reference evapotranspiration ($ET_o$)

Litvak *et al*. 2017, *Water Resources Research*

# Calculating Residential Vegetation Water Demand

**Step 1.** Calculate total residential vegetation area

Tree canopy + Unshaded turf

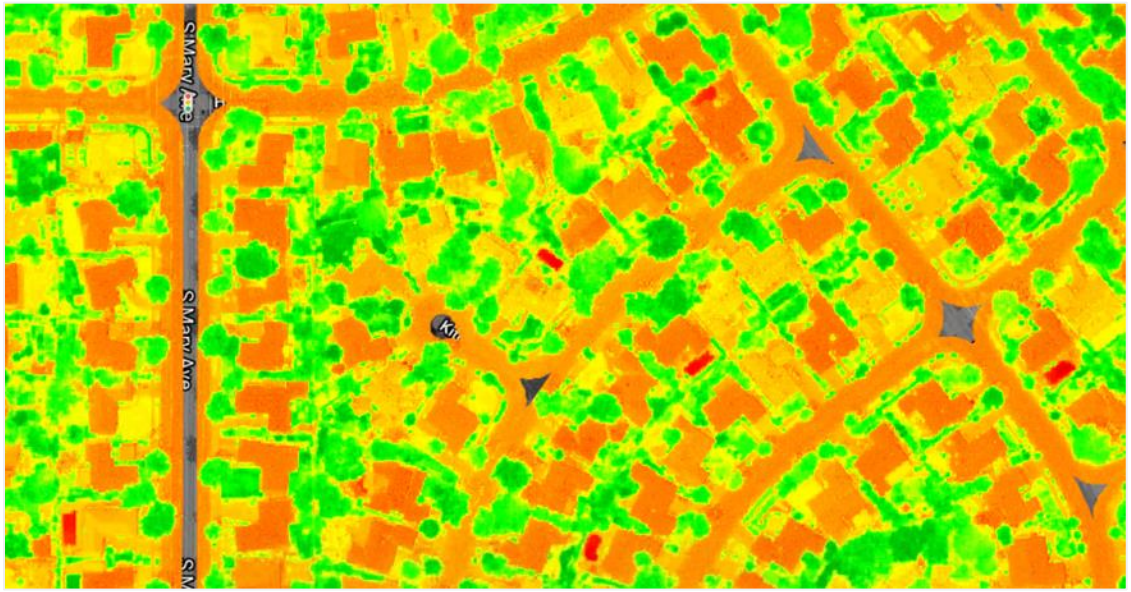
# Defining residential areas

- Aggregate residential parcels within each Supplier's boundaries
- Buffer to capture tree canopy
- Clip buffer to remove non-residential parcels
- 384 Suppliers with adequate parcel data for this method

# Total vegetated area

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

- Calculated NDVI from NAIP 2018 imagery (0.6m res)
- Pixels with NDVI values ≥0.2 = vegetation
- Example: Sunnyvale
  - Green = vegetation
  - Orange/red = impervious/water
  - Gray = area outside buffer

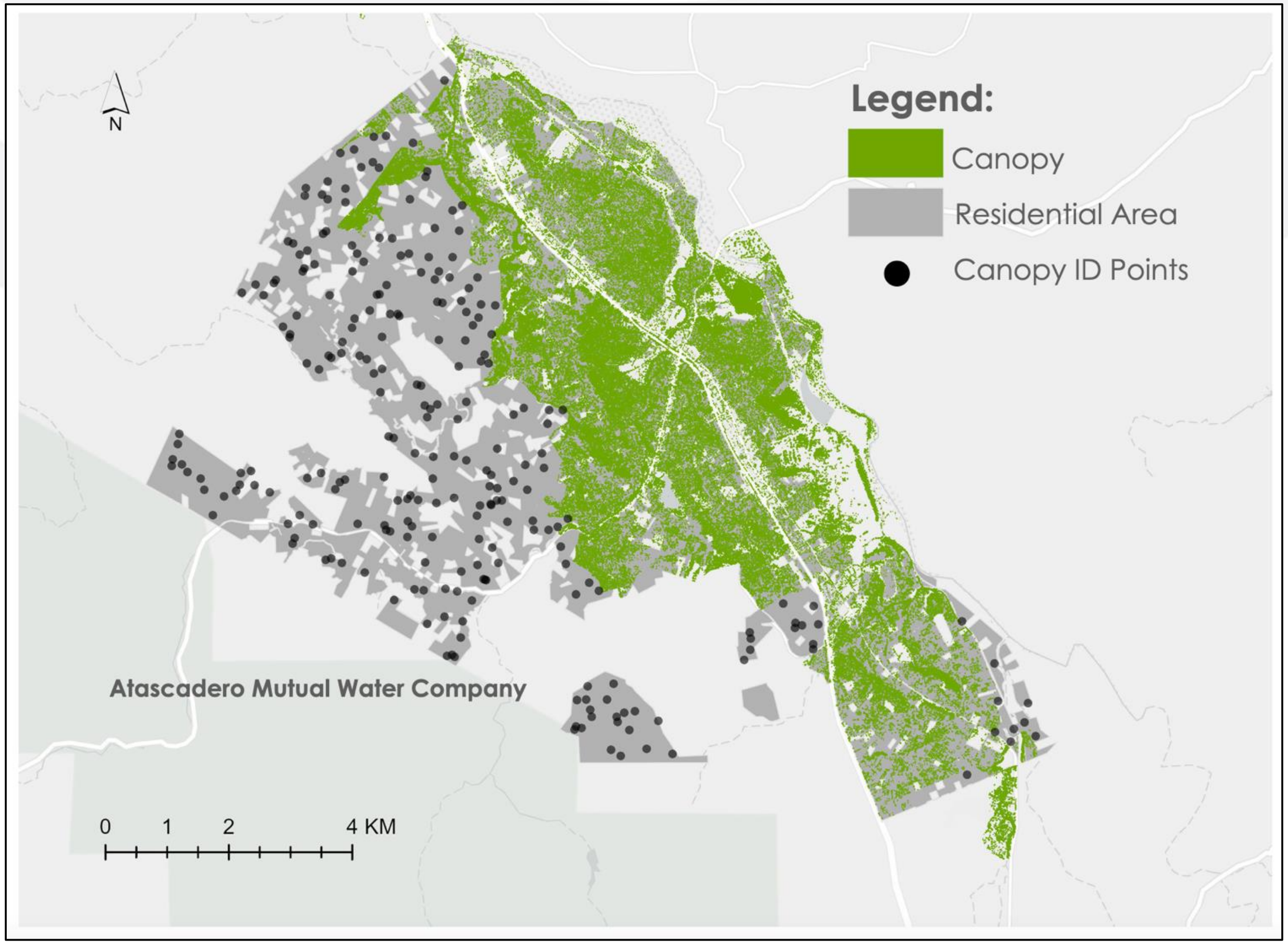
# Tree canopy area

- EarthDefine US Tree Map
- California urban areas available through USFS & CAL FIRE for 2018
- Created using AI
- 97.3% accuracy for the entire country


Sacramento

# Point estimates for missing canopy areas

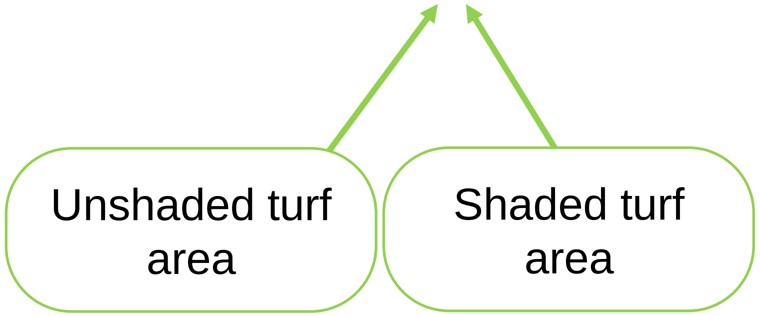
- Canopy map doesn't cover all residential areas within supplier boundaries
- To estimate canopy cover in areas without data, used point counts:
  - <10% missing – use overall % canopy cover
  - 10-25% missing – 100 points
  - >25% missing – 250 points



# Calculating Residential Vegetation Water Demand

## **Step 2.** Calculate water demand of **turf**

Water demand = $k_{mc}$*$ET_o$




- Unshaded turf area = total vegetated area – canopy area
- Shaded turf area = 50% canopy area
  - Min: 25%
  - Max: 75%
- Total turf area = shaded + unshaded
- $k_{mc}$ = 0.9 – 0.35 * ($A_{shaded}$/$A_{total}$)
- $ET_o$ from Spatial CIMIS (2014-2019)

Litvak *et al*. 2017, *Water Resources Research*

# Calculating Residential Vegetation Water Demand

## **Step 3.** Calculate water demand of **trees**

Data needs for each Supplier:

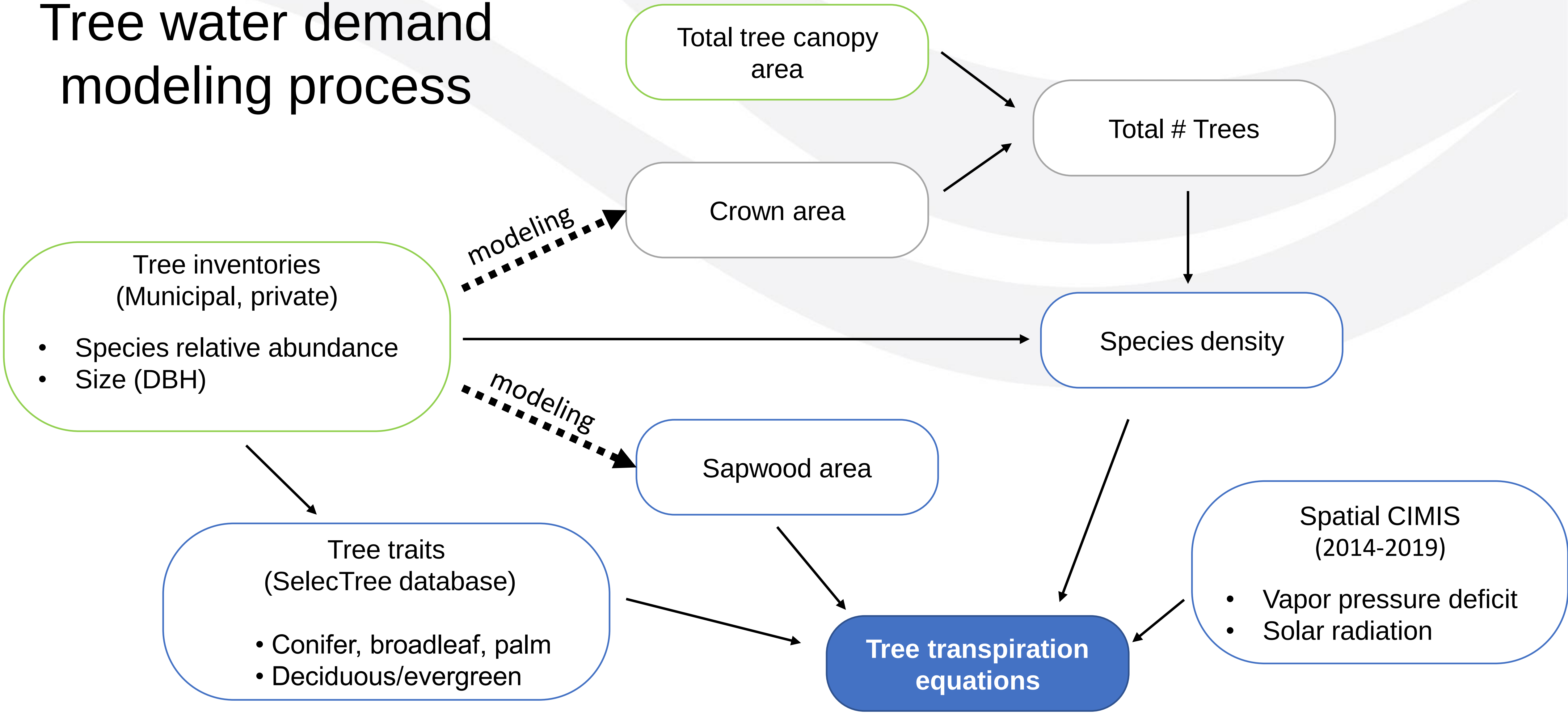
- Total # residential trees
- Relative abundance of each species
- Size (DBH) distribution of each species
- Type and deciduous/evergreen
- Mean sapwood area of broadleaf trees and conifers
- VPD and solar radiation

Water demand = $E_{broadleaf} + E_{conifer} + E_{palm}$

*E = transpiration*

Litvak *et al*. 2017, *Water Resources Research*

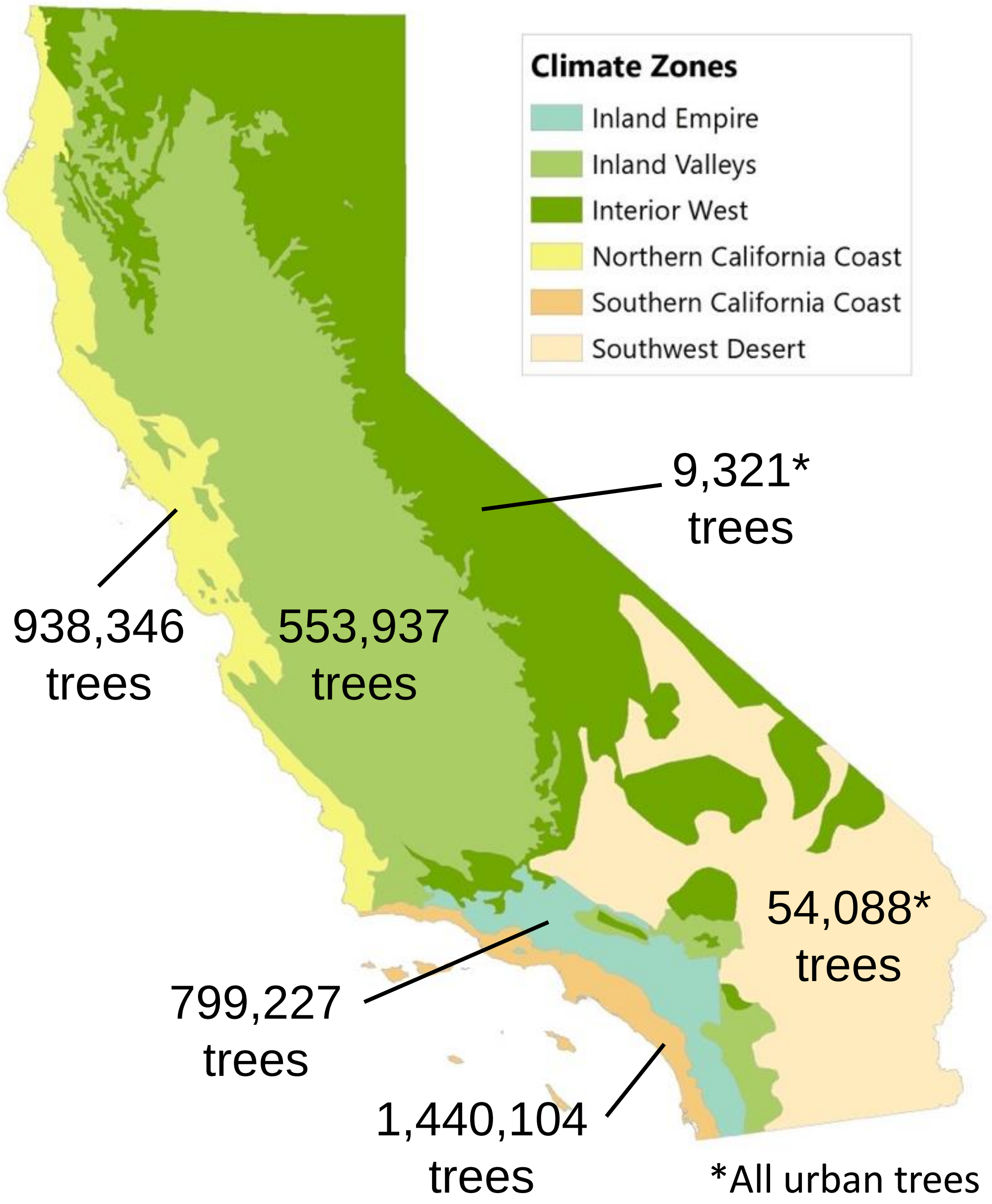
# Tree water demand modeling process



# CA urban tree inventories

>3.5 million trees in residential areas within Supplier boundaries

| | Suppliers with data | Suppliers without data |
|---|---|---|
| Inland Empire | 54 | 17 |
| Inland Valleys | 38 | 75 |
| Interior West | 0 | 5 |
| Northern CA Coast | 47 | 28 |
| Southern CA Coast | 82 | 17 |
| Southwest Desert | 2 | 19 |
| Total | **223** | **161** |



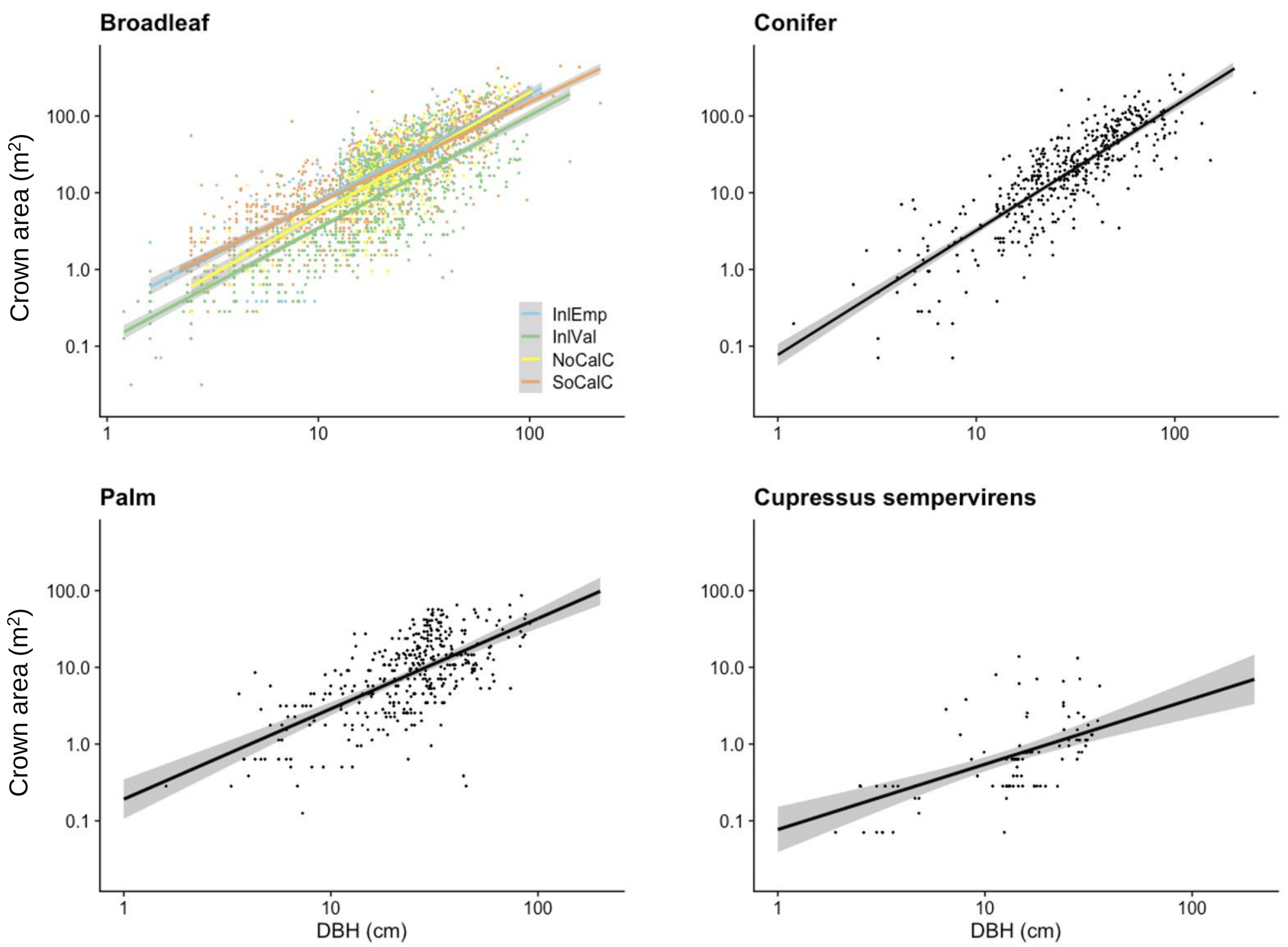

Map source: McPherson *et al*. 2016, *Urban Forestry & Urban Greening*

# Calculate total trees from mean crown area

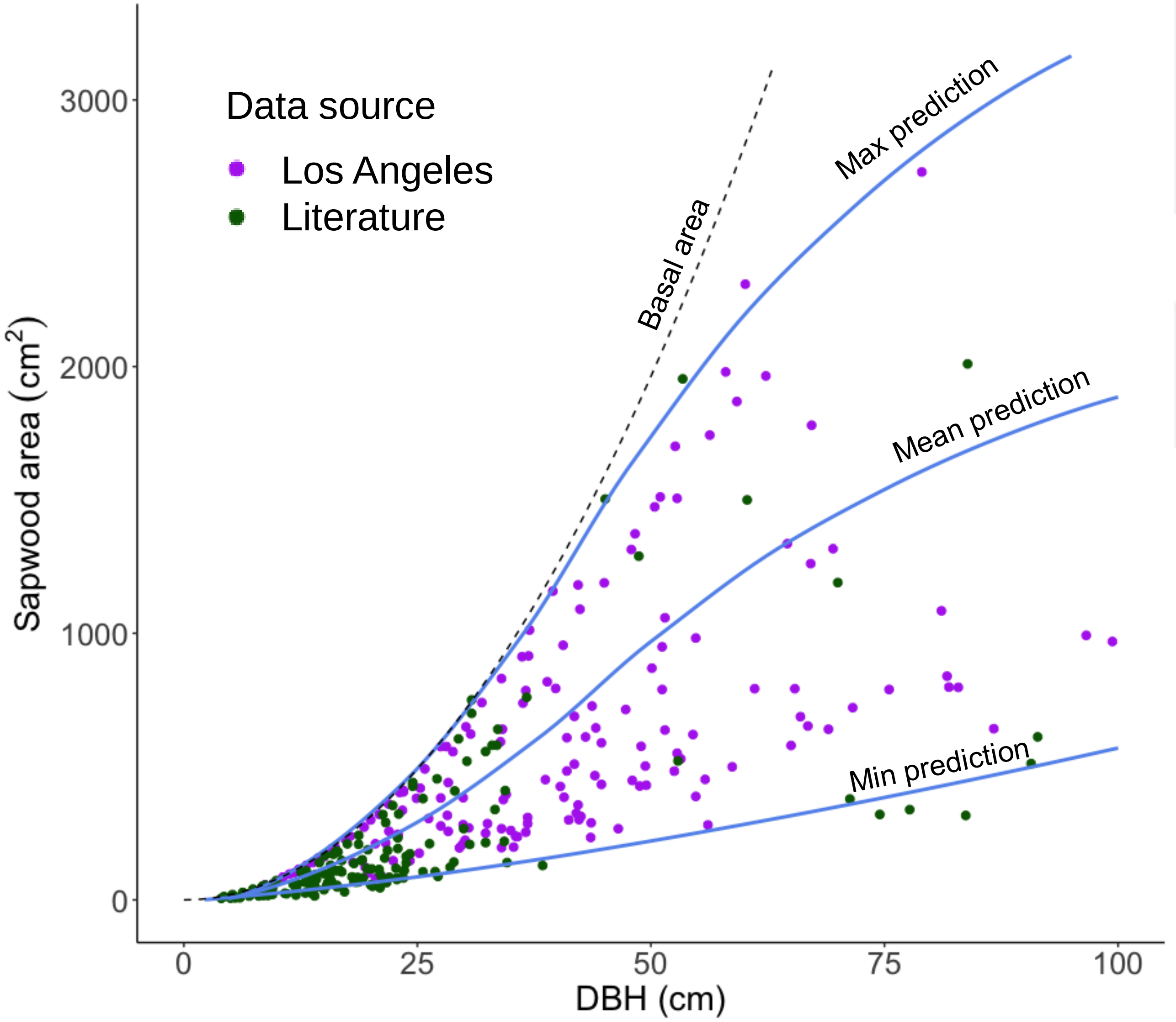
- USFS FIA/Eco-plot data
- Equations relate tree crown area to DBH

For each Supplier:

1) Calculate crown area for each tree; take mean
2) Total trees = total canopy area/ mean crown area
3) Density$_i$ = total trees * relative abundance$_i$



# Sapwood area ~ DBH equations from LA and literature




- Original data from studies in Los Angeles
- Literature search for the 200 most common species
- Species-specific equations for 37 species representing 31% of trees
- For other species, use mean, max, min predictions – greater uncertainty

# Tree water demand calculation

- Broadleaf trees:

  $E_{broadleaf(i)} \sim d_i, A_{s(i)}, VPD, R_s, k_{broadleaf}$

  *For deciduous trees, $E_{broadleaf(i)} \approx 0$ when trees are leafless

- Conifers:

  $E_{conifer(i)} \sim d_i, A_{s(i)}, VPD, R_s, k_{conifer}$

- Palms:

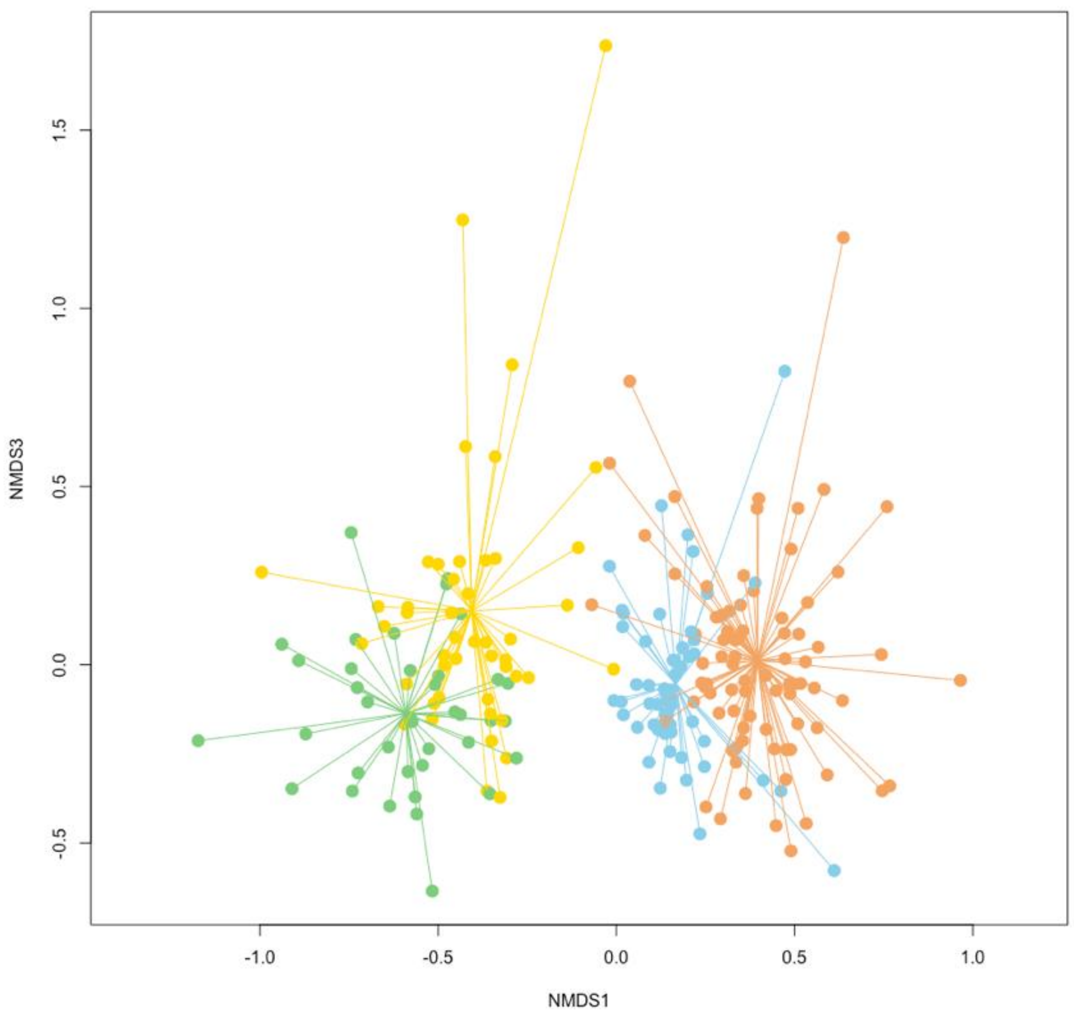
  $E_{palms} \sim d_{palms}, k_{palms}$

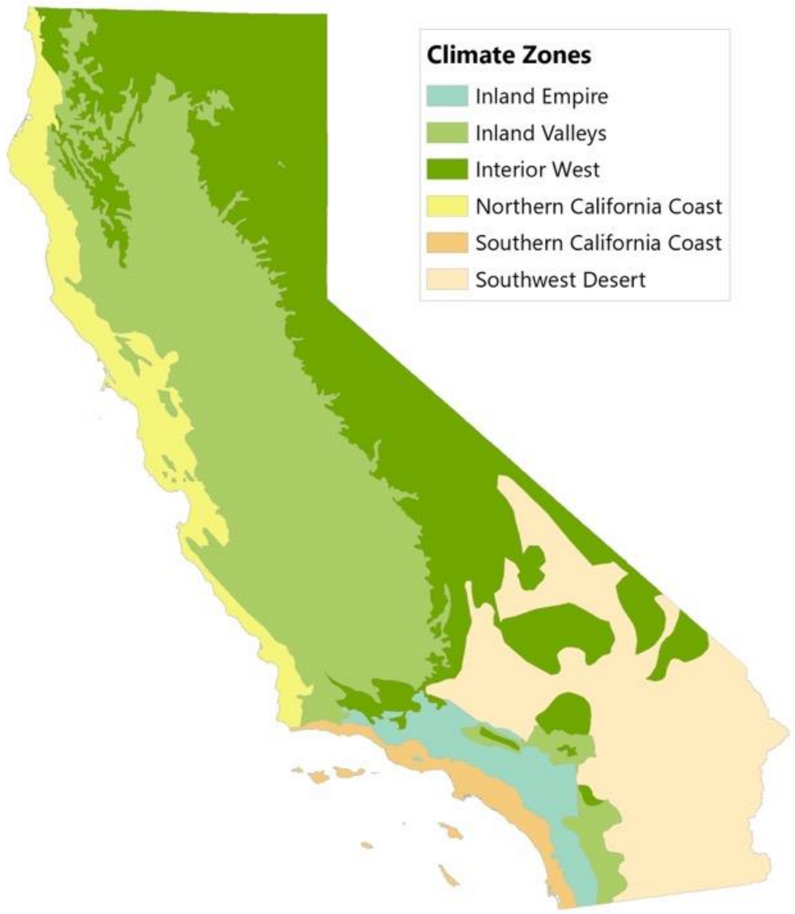
**Key**
$E$ = transpiration (mm)
$d$ = density (trees/ha)
$A_s$ – sapwood area ($cm^2$)
$VPD$ = vapor pressure deficit (kPa)
$R_s$ = solar radiation ($W\ m^{-2}$)

$$E_{trees} = \Sigma E_{broadleaf(i)} + \Sigma E_{conifer(i)} + E_{palms}$$

# Approach for Suppliers without tree inventory data

- Tree species composition tends to separate by climate zone
- Model unknown urban forests by climate zone

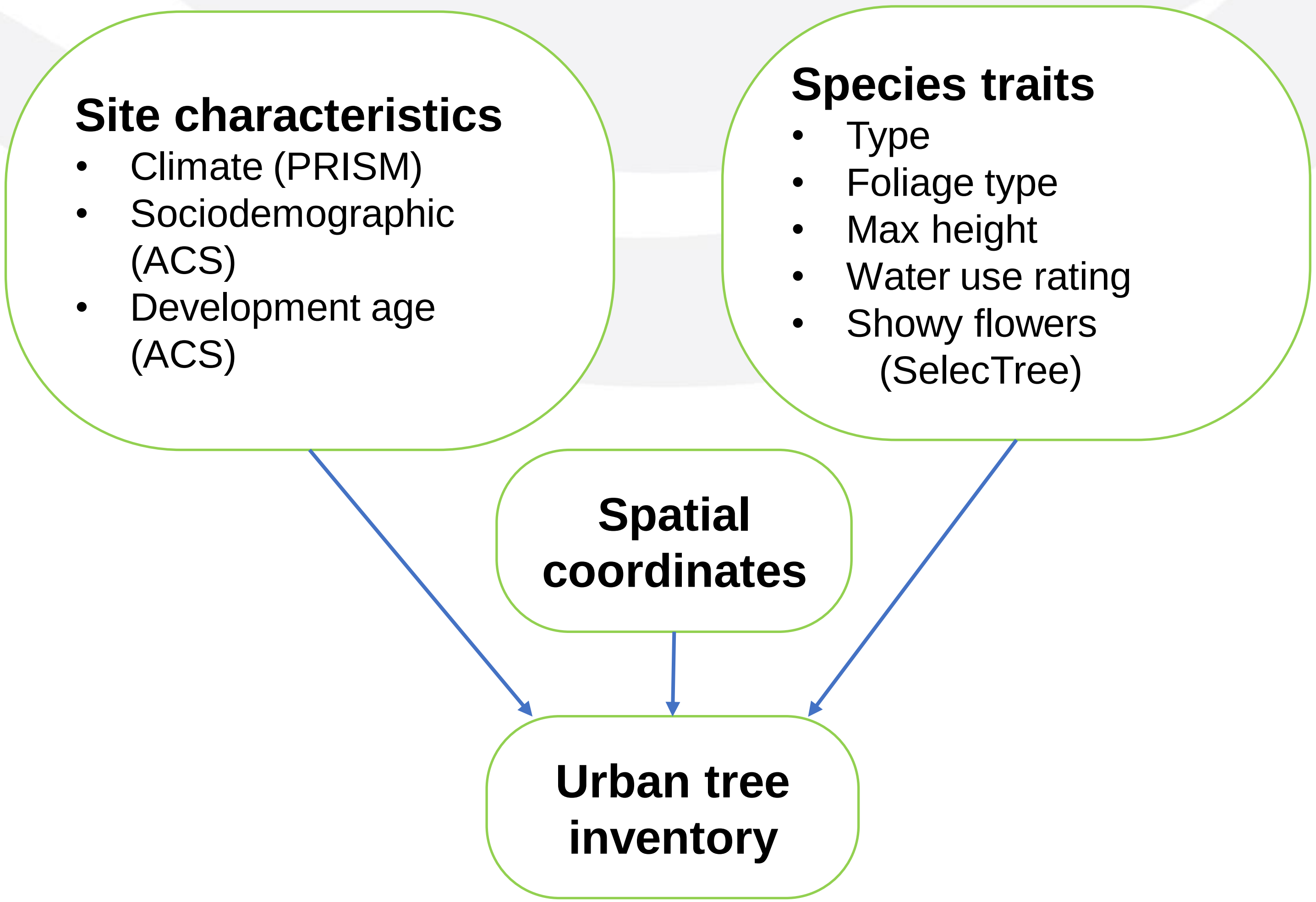


# Modeling urban forest composition

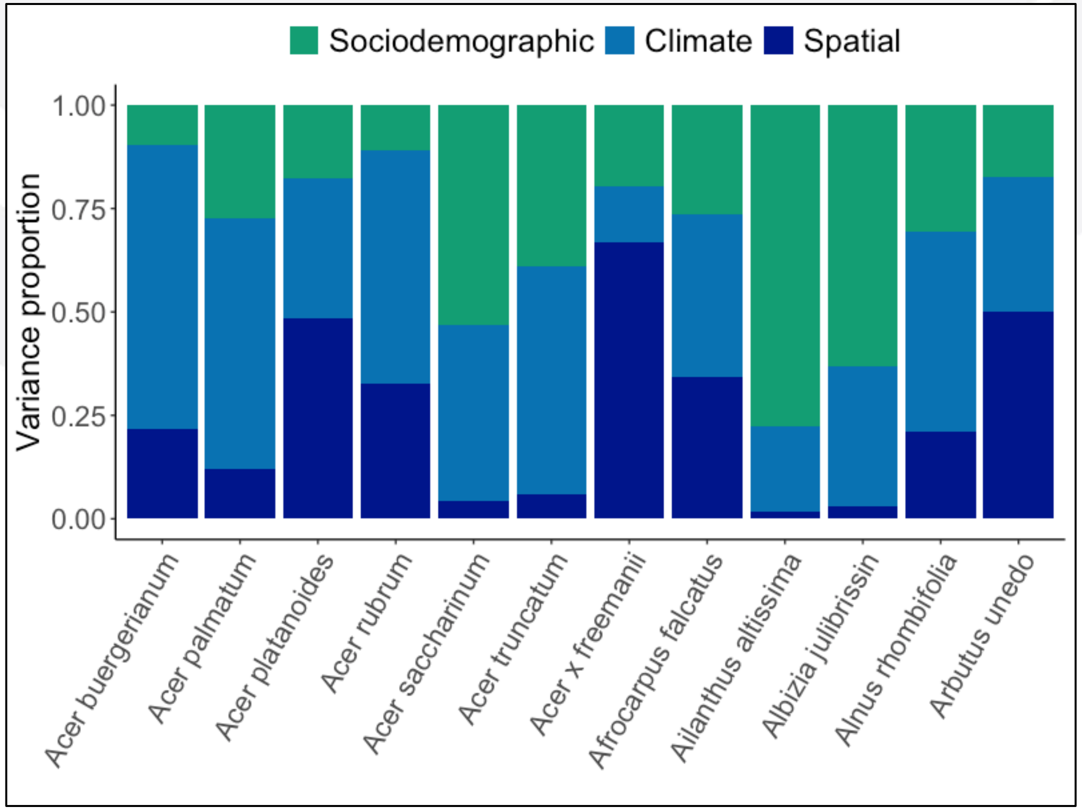
- Joint species distribution modeling using the Hierarchical Modeling of Species Communities (HMSC) framework

- Model within climate zones at the zip code level
  - Include buffer
  - Most common species
  - Zip codes with ≥ 2000 trees & ≥ 2 trees/ha

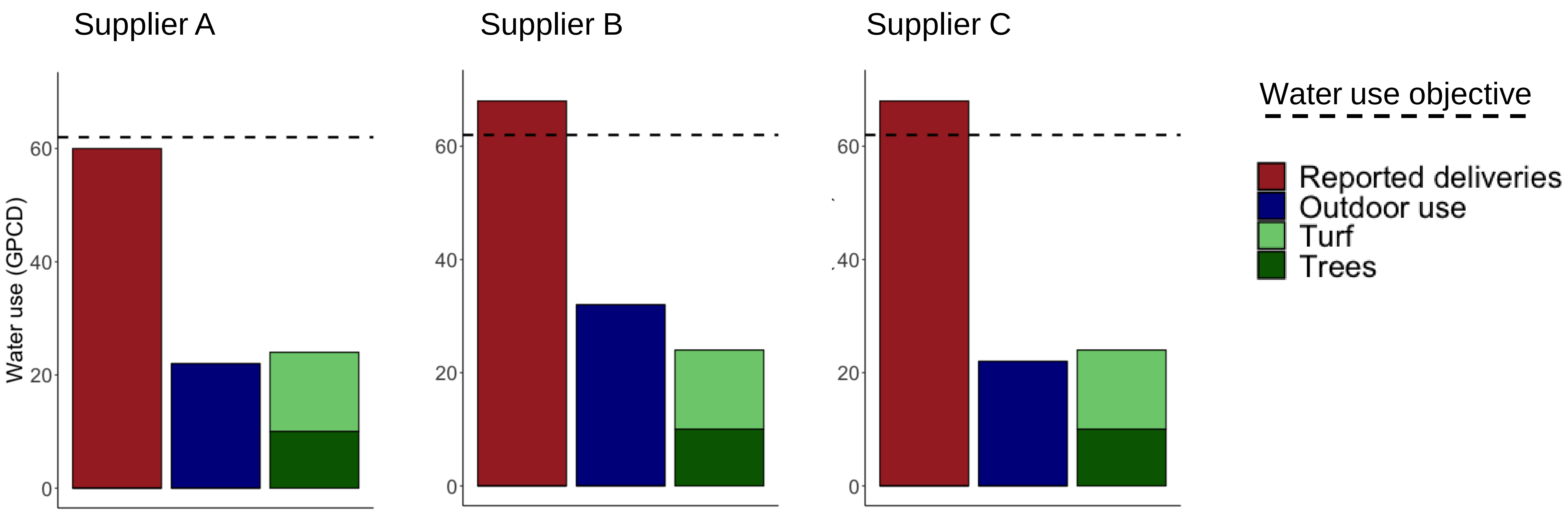


# Predictions based on zip code characteristics

- Model predicts composition for all zip codes
- For each zip code without data, determine similar zip codes with data (Bray-Curtis)
- Calculate $E_{trees}$ for all identified zip codes using Supplier climate data
- Use weighted mean; min-max range



# Compare water demand and use with objectives



# Risk assessment for residential trees

1. Will a reduction in water use be needed to meet the new objective?
2. Does total vegetation water demand exceed projected outdoor water use?
   a) Would tree water use alone exceed outdoor water use?
   b) Is it likely that trees are using non-irrigation water sources?
3. Could precipitation fill the deficit?
4. What percentage of trees are rated as low water use?
5. Is climate expected to become warmer and/or drier?

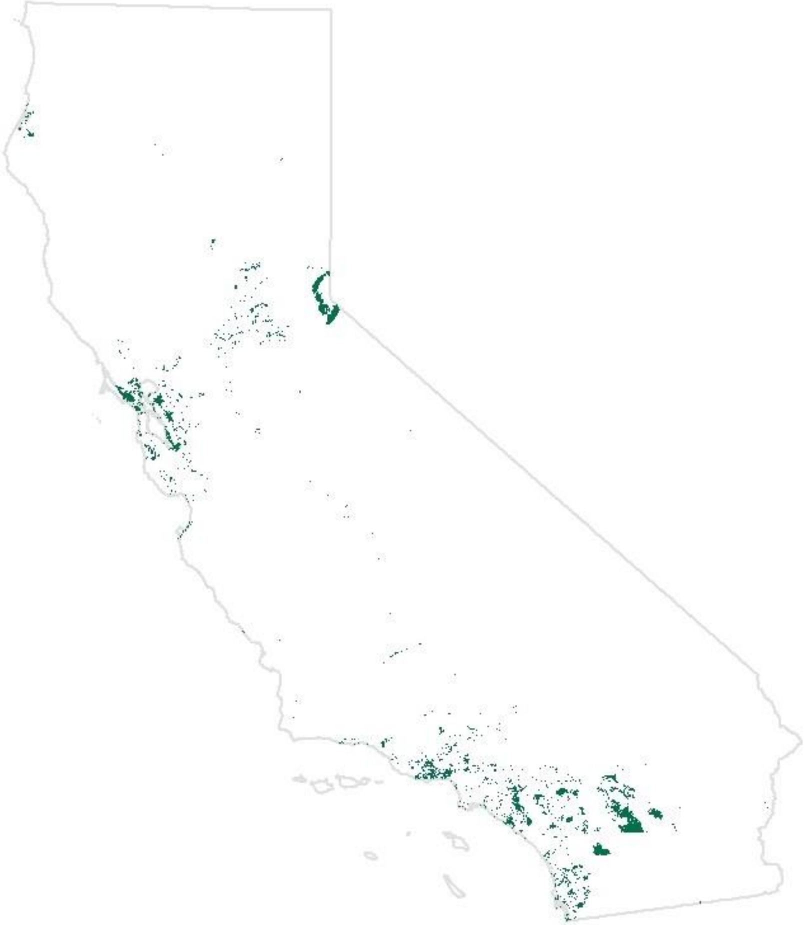
# Evaluating Effects on Urban Parklands

- Evaluate parklands within urban retail water supplier boundaries
- Identify case study agencies
- Outreach & semi-structured interviews with park managers
- Analyze interview findings

# California Protected Areas Database

All CPAD acres
~50,000,000

CPAD acres within project retailers
~1,400,000 acres



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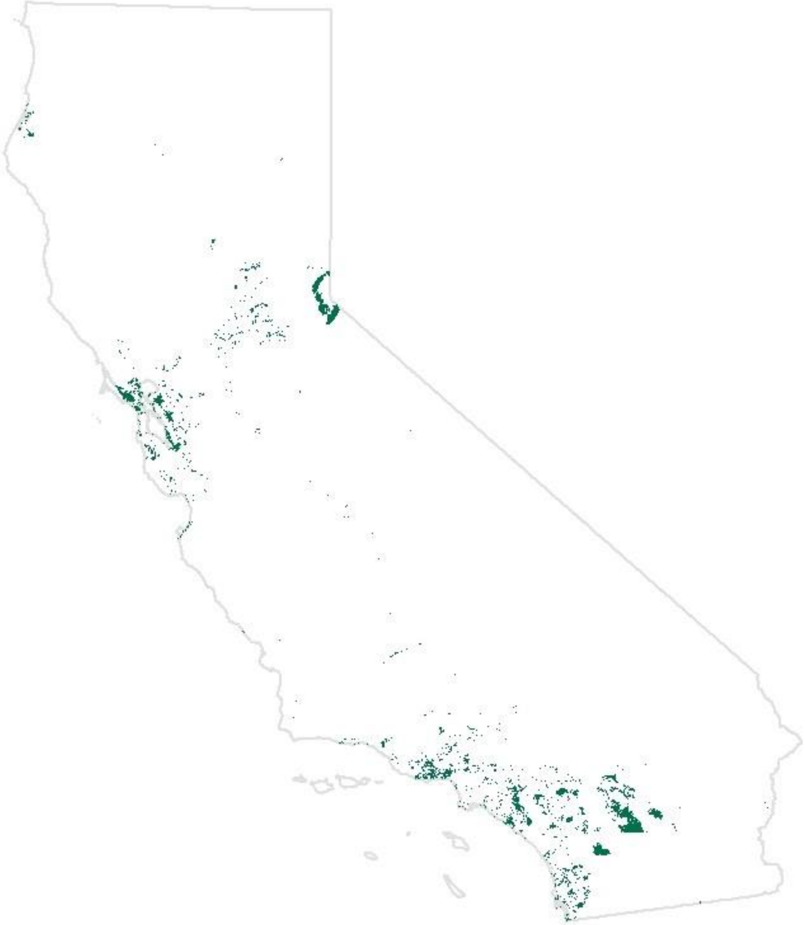
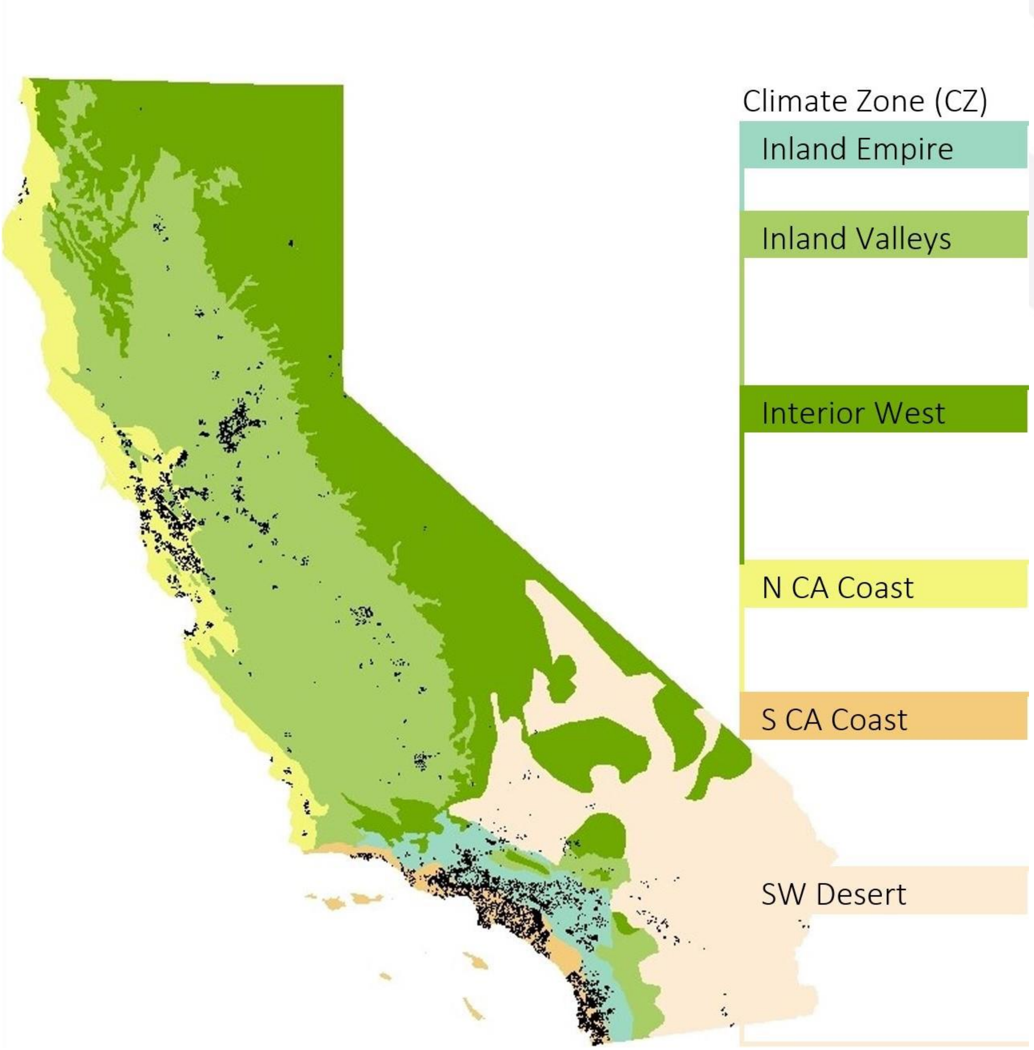
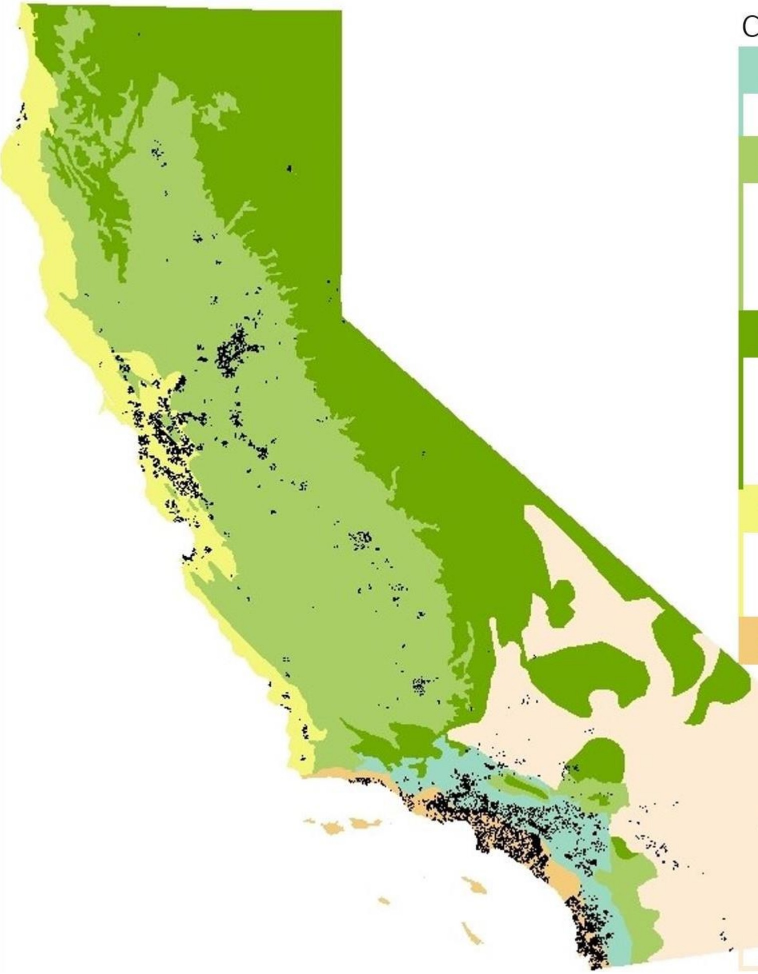


| | |
|---|---|
| FID | 46 |
| ACCESS_TYP | Open Access |
| UNIT_ID | 190 |
| UNIT_NAME | Augustus Hawkins Natural Park |
| SUID_NMA | 15707 |
| AGNCY_ID | 1188 |
| AGNCY_NAME | Los Angeles, City of |
| AGNCY_LEV | City |
| AGNCY_TYP | City Agency |
| MNG_AGENCY | Los Angeles, City of |
| MNG_AG_LEV | City |
| MNG_AG_TYP | City Agency |
| PARK_URL | |
| COUNTY | Los Angeles |
| ACRES | 8.369 |
| LABEL_NAME | Augustus Hawkins Natural Park |
| YR_EST | 0 |
| DES_TP | Local Park |

# Park Outreach & Case Studies



# Park Outreach & Case Studies



| Climate Zone (CZ) | URWS | Parks in CZ | Acres in CZ | % Parks in CZ | % Acres in CZ | % Acres in City/ County |
|---|---|---|---|---|---|---|
| Inland Empire | 40 | 52 | 3,361 | 3% | 5% | 0% |
| | 3 | 41 | 623 | 2% | 1% | 2% |
| Inland Valleys | 2 | 55 | 1,650 | 2% | 4% | 2% |
| | 2 | 88 | 1,287 | 4% | 3% | 2% |
| | 4 | 207 | 3,595 | 8% | 8% | 6% |
| | 10 | 15 | 7,095 | 1% | 15% | 1% |
| Interior West | 1 | 9 | 203 | 20% | 36% | 2% |
| | 1 | 5 | 118 | 11% | 21% | 1% |
| | 1 | 7 | 29 | 13% | 4% | 0% |
| | 1 | 9 | 88 | 17% | 12% | 0% |
| N CA Coast | 3 | 196 | 2,650 | 10% | 5% | 9% |
| | 3 | 182 | 1,577 | 9% | 3% | 1% |
| | 1 | 28 | 104 | 1% | 0% | 2% |
| S CA Coast | 7 | 32 | 4,804 | 1% | 4% | 0% |
| | 10 | 460 | 20,732 | 15% | 16% | 13% |
| | 2 | 118 | 1,917 | 4% | 2% | 6% |
| | 3 | 43 | 821 | 1% | 1% | 7% |
| SW Desert | 1 | 13 | 93 | 6% | 4% | 1% |
| | 1 | 10 | 243 | 4% | 8% | 0% |
| | 1 | 21 | 67 | 9% | 2% | 1% |
| | 1 | 15 | 129 | 6% | 4% | 3% |

Outreach with city and county agencies to target urban parklands.

# Semi-Structured Interviews

- **With park managers & superintendents**
  - Presence of dedicated meters
  - Water supply sources
  - Irrigation regimes & technology
  - Resources for adaptation

# Semi-Structured Interviews

- **With park managers & superintendents**
  - Presence of dedicated meters
  - Water supply sources
  - Irrigation regimes & technology
  - Resources for adaptation
- **Coding Interviews**
  - Organizational attitudes towards climate change & increasing water scarcity
  - Organizational attitudes towards drought-tolerant landscaping
  - Expectations of future economic expansion/population changes
  - Organizational desire for measurement & rationalization of water consumption practices

# Special Thanks

CalWEP, Alliance for Water Efficiency

Urban retail water supply community

Wastewater management community, including CASA, SCAP, BACWA, CVCWA, CWEA

Urban parkland management community

Dongyue Li, Ruth Engel, Dennis Lettenmaier, Tom Gillespie (UCLA)

Matthew Ritter, G. Andrew Fricker (Cal Poly SLO)

Diane Pataki (Arizona State), Liza Litvak (University of Utah)

**Contact: erik.porse@owp.csus.edu**

# Short Break (10 minutes)

# Presentation Highlights

- Vegetation demand for trees and turf on residential properties is being estimated for urban areas across the state using a bottom-up approach based on experimental data collection and ecological modeling
- Tree inventory data, including species composition and size, is being used to evaluate water demand of the existing urban residential tree canopy and differences in tree water demand across climate zones
- A risk-based approach is being used to evaluate potential effects of water demand reductions from AB 1668-SB 606 on urban trees, including comparing modeled vegetation demand with observed outdoor demand for urban retail water suppliers with likely reductions

# Presentation Highlights

- Limited information exists on current water management practices in urban parklands. Interviews and outreach were conducted with park managers across the state to evaluate existing water and irrigation management habits, as well as sources of data for urban park boundaries
- For cities and counties that manage urban trees and parks in affected areas, mitigation and adaptation actions to deal with climate change and water demand reductions will likely include changing irrigation habits, planting climate appropriate trees and shrubs, reducing turf, and increasing public education programs on irrigation needs of landscapes

# Planned Schedule

Wastewater, Parklands, and Trees

| Step | Date |
| --- | --- |
| Release draft methods document for public comment | February 2022 |
| Methods document comment period | February- March 2022 |
| Publish draft report for public comment | April 2022 |
| Review and address comments | End of May – July 2022 |
| Publish final report | September 2022 |

# Planned Schedule

AB 1668/SB 606 rulemaking

| Step | Date |
| --- | --- |
| **Receive recommendations from DWR** | **This winter** |
| Start Rulemaking Process | Spring 2022 |
| Adoption | Spring 2023 |
| Effective Date | Fall 2023 |

# Q&A

- Please use the "hand raise" function
- When called, state your name, agency, and question

# Next Steps

- Upload presentations and recording to website
- Schedule additional meetings
- Start Rulemaking

# Where to find more information

- **State Water Resources Control Board**
  - Water Conservation Portal
    - www.waterboards.ca.gov/water_issues/programs/conservation_portal/
  - About SB 606 & AB 1668:
    - www.waterboards.ca.gov/water_issues/programs/conservation_portal/california_statutes.html
  - About the rulemaking process:
    - www.waterboards.ca.gov/water_issues/programs/conservation_portal/regs/water_efficiency_legislation.html

- **Department of Water Resources**
  - Primer of 2018 Legislation on Water Conservation and Drought Planning
  - About urban water use efficiency, including SB 606 & AB 1668:
    - https://water.ca.gov/Programs/Water-Use-And-Efficiency/Urban-Water-Use-Efficiency
  - Sharepoint site with materials for DWR workgroup members only:
    - https://cawater.sharepoint.com/sites/dwr-wusw/SitePages/Home.aspx

# Thank you!

Contact: ORPP-WaterConservation@waterboards.ca.gov with questions