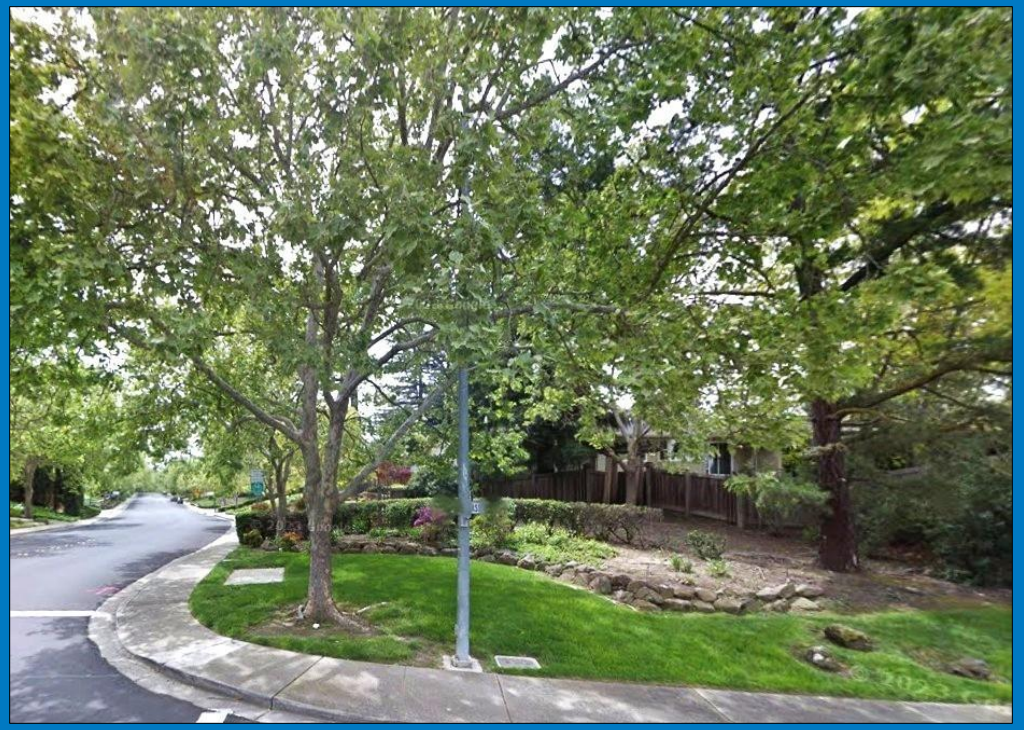
EBMUD Landscape Advisory Committee, General Meeting

Protecting Mature Trees Through Lawn Conversion Projects

March 4, 2026



Kristin.Bowman@ebmud.com

Lindsay.Kinsler@ebmud.com

Announcements

- Events
  - Ruth Bancroft Water-Wise Garden Tour 4/25/26
  - Bring Back the Natives Garden Tour 5/2/26 -5/3/26
  - East Bay Public Gardens Open House 6/6/26
- EBMUD Water Supply (precipitation -100% of average upcountry; 97% local)
- Rebates
  - CII Treebate Pilot – up to $100/tree/3 trees; Residential 1 tree.
  - CII Spring Irrigation Repair Pilot – up to $1000/account
  - CII Landscape rebates – up to $15,000; 5k bonus (2026). Residential up to $2000.
  - CII Non-Functional Turf Watering Ban (potable)
    - Municipal Properties 2027; Commercial/Institutional 2028
    - HOA 2029; DAC 2031
    - New state resources at Nonfunctionalturfca.org; EBMUD nonfunctional turf (webpage)
- Watershed Progressive Mature Tree Health Survey
- CEU's available for this webinar – ReScape, AWWA, Master Gardeners, QWEL

City

Protecting Mature Trees Through Lawn Conversions Overview

Protecting Trees Darya Barar - Urban Forester with Bartlett Trees | HortScience, dbarar@bartlett.com

- Tree benefits/planning
- Tree protection zone and root zone
- Irrigation do's and don'ts
- Mulch and plant considerations
- Final Tips!

Tree Irrigation Scheduling Christine.Hawkins@hunter.global - Specifications Manager
Chris.McNairy@hunter.global - Sales Manager

- Tree water demand; water storage in the root zone; water supplied by irrigation
- Irrigation scheduling calculations
- Tree irrigation calculator/excel spreadsheet
- Final Tips!

Protecting Trees in Lawn Conversion Projects

Darya Barar

EBMUD Landscape Advisory Committee
March 4, 2026

Introduction

Darya Barar

Managing Consulting Arborist & Urban Forester, H | BC

dbarar@bartlett.com

Why trees matter?

Why care about trees?

- Ecosystem services
- Social sustainability
- Economic sustainability
- Equity

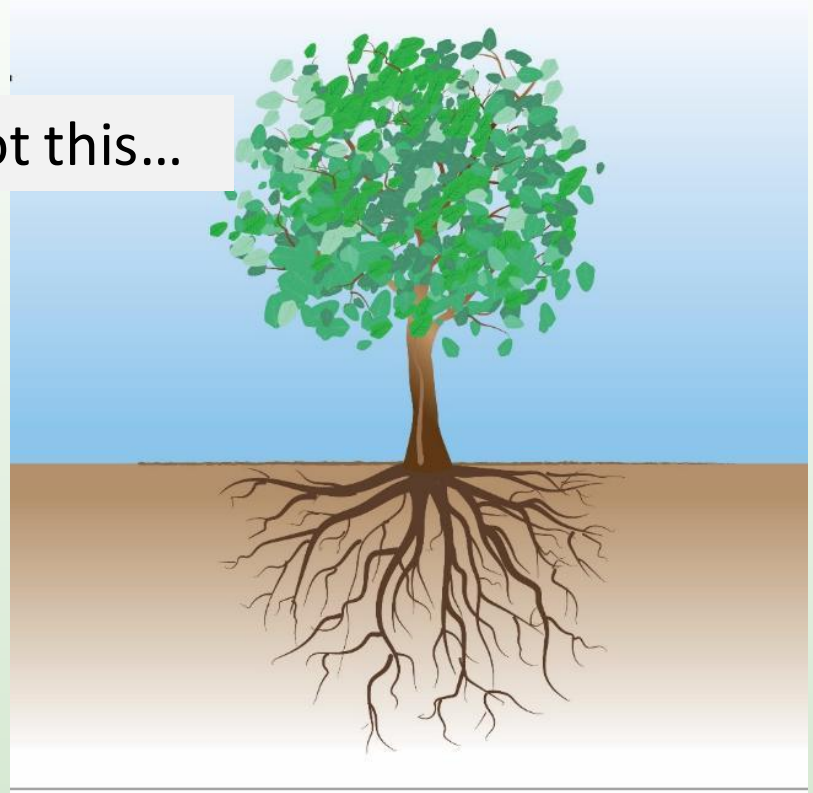
Why trees matter?

How to plan to support trees?

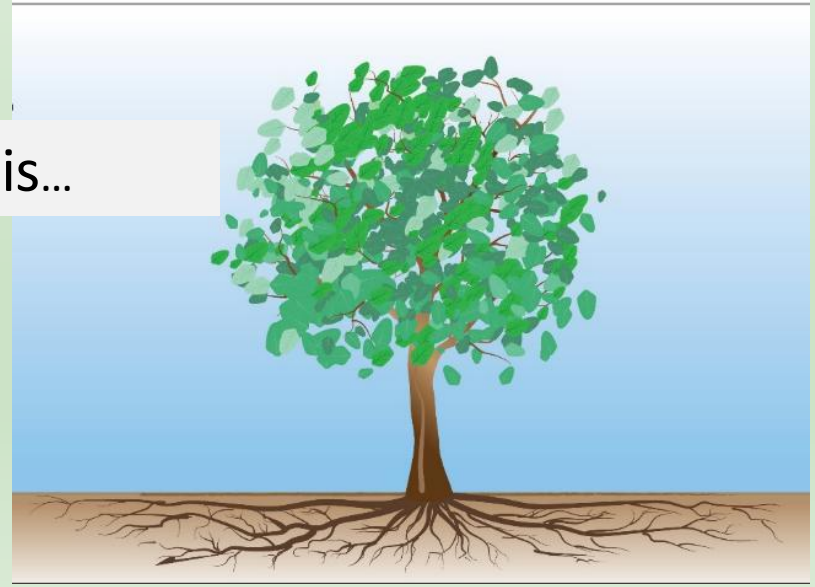
- With landscape changes, impacts can be significant
- Work with an arborist to understand which trees will benefit the site in the future

How do landscape conversions affect trees?

Not this…



This…



Roots grow where soil is

- moist
- aerated
- permeable

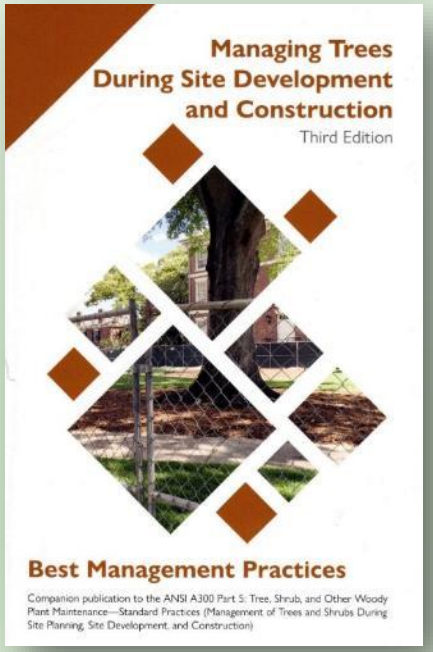
In the Bay Area, most roots are shallow

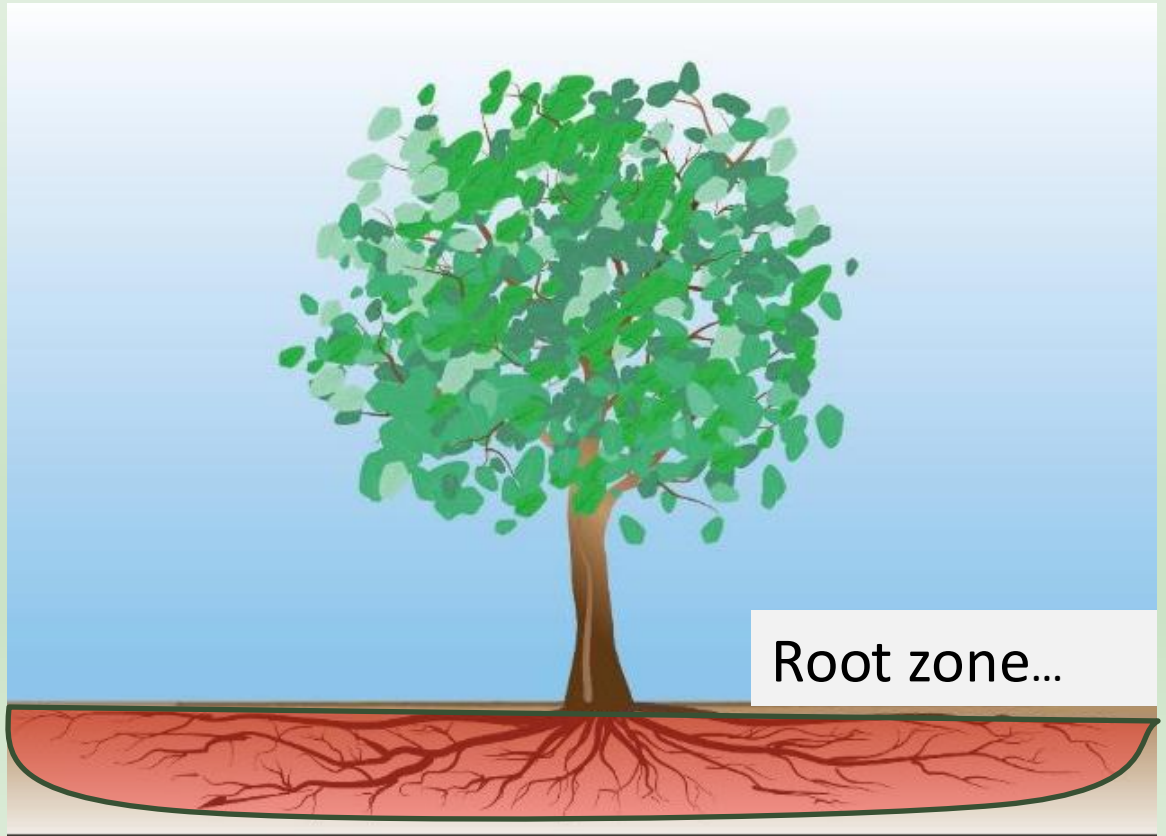
- most roots are in the top 18”
- most fine roots are in top 6”

Definitions

C*ritical* **Root Zone** is the minimum volume of roots needed for stability. However, no universally accepted way to calculate it.

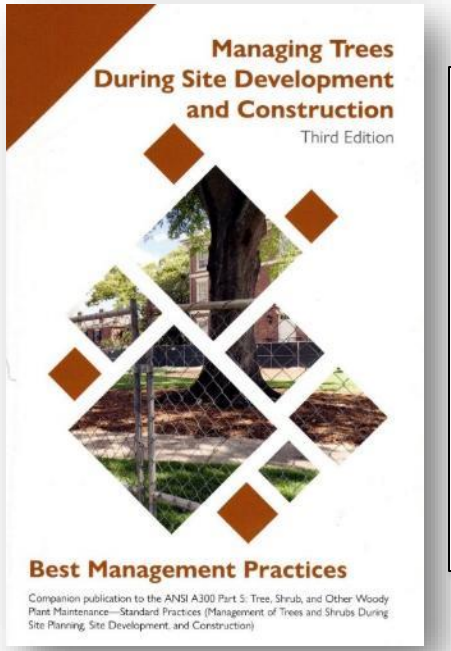
The Tree Protection Zone (TPZ) is an area in which certain activities are prohibited or restricted to prevent or minimize potential injury to designated trees…





What is the Tree Protection Zone?

The *calculated* TPZ is determined by evaluating the species' tolerance to construction and multiplying that factor by the trunk diameter



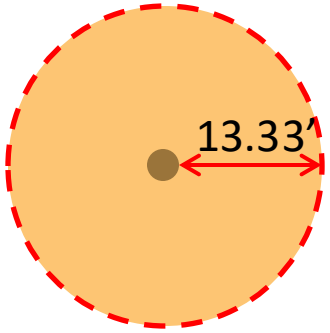
Species Tolerance to Construction Damage	Relative Tree Age*	Multiplication Factor
High	Young or semimature	6
	Mature	8
	Old	12
Medium	Young or semimature	8
	Mature	12
	Old	15
Low	Young or semimature	12
	Mature	15
	Old	18

What is the Tree Protection Zone?

Species Tolerance to Construction Damage	Relative Tree Age*	Multiplication Factor
High	Young or semimature	6
	Mature	8
	Old	12
Medium	Young or semimature	8
	Mature	12
	Old	15
Low	Young or semimature	12
	Mature	15
	Old	18

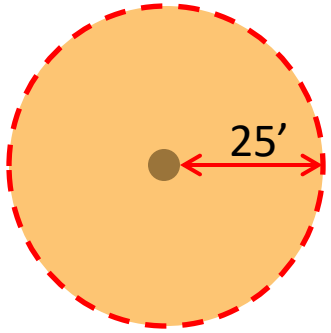
20” trunk diameter coast live oak (good root tolerance)

20*8 = 160”/12 = 13.33’



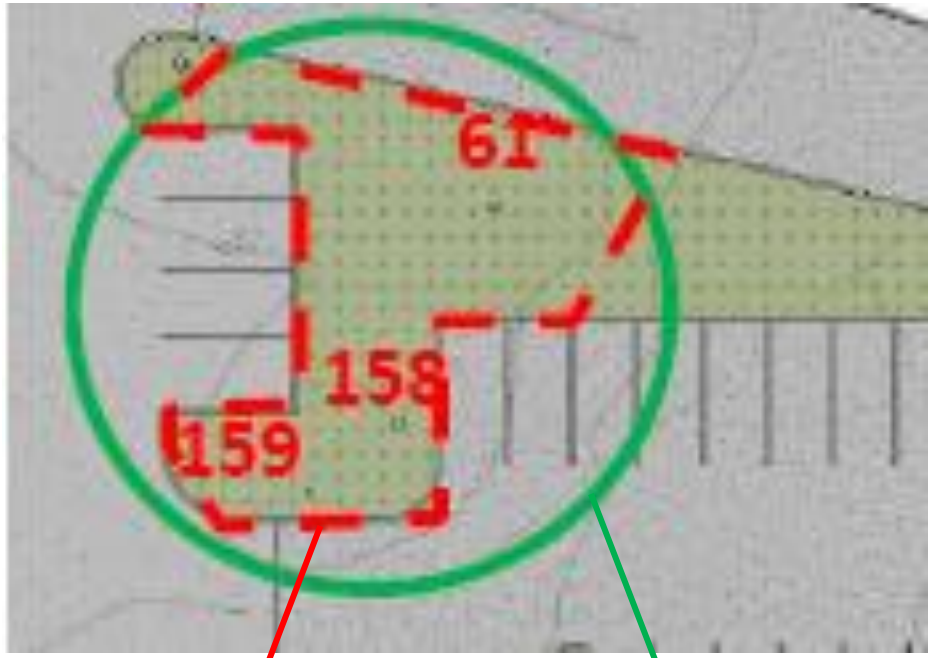
20” trunk diameter black walnut (poor root tolerance)

20*15” = 300”/12 = 25’



What is the Tree Protection Zone?

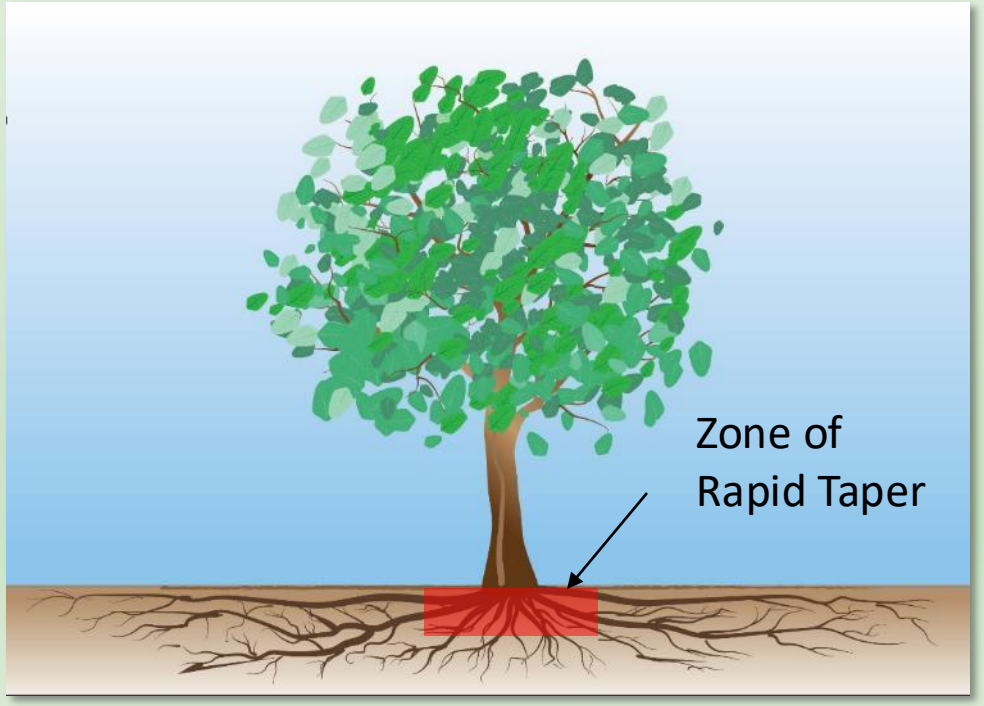
The *specified* TPZ is the adjusted to area that accommodate the existing infrastructure or planned construction…



Specified TPZ *Calculated* TPZ

Zone of Rapid Taper

- Large roots within about 5’ of trunk
- Important to tree stability

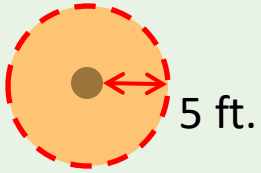


Roots are highly influenced by site conditions

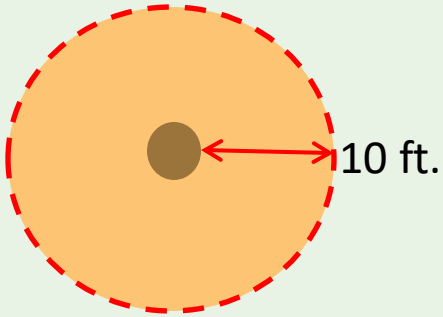
TPZ for minimal landscape changes

Suggested minimum TPZ for landscape projects

Small trees



Large trees



Converting turf to water-wise landscape

Water Stress

https://friendsofthepublicgarden.org/

https://sodsolutions.com

Converting turf to water-wise landscape

<u>To minimize injury in the root zone…</u>

Irrigate to avoid tree water stress during conversion

- Hand watering (slow rate, for long periods)
- Multiple water bags
- Temporary irrigation system

Avoid removing turf during hot weather

Converting turf to water-wise landscape

Excavation to install irrigation
cuts tree roots

Orbitonline.com

Converting turf to water-wise landscape

To minimize tree root injury

- Tunnel under woody roots.
- Keep new irrigation trenches and valve boxes outside the TPZ.
- Leave turf irrigation lines in place and modify for new plants.
- Place irrigation lines on top of soil and cover with 3 to 4 inches mulch.

Converting turf to water-wise landscape

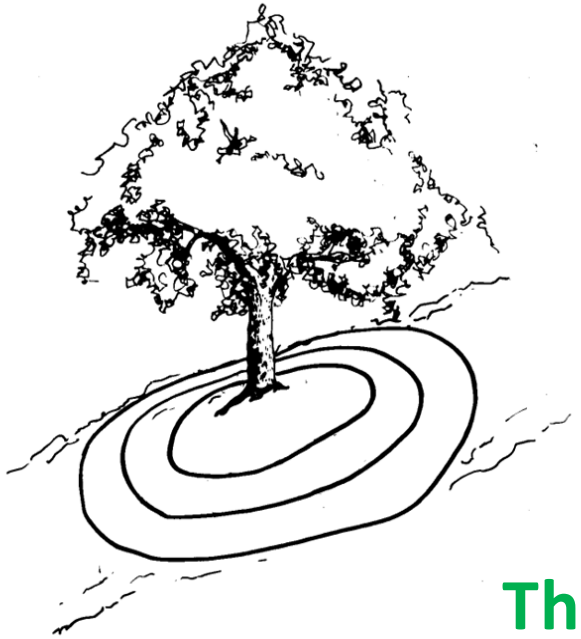
Avoid install new plants within TPZ

Converting turf to water-wise landscape

A few notes on irrigation…

<u>Drip is preferred</u>

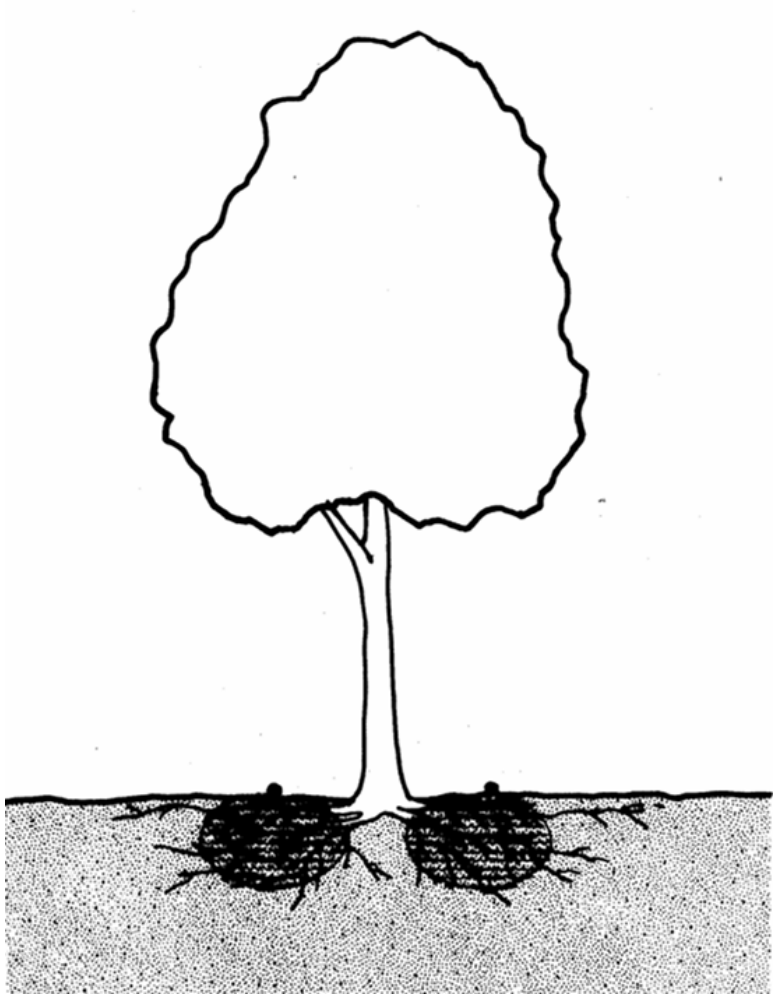
- Place drip in contact with soil – where feeder roots are growing
- 12” emitters with lines spaced 18” apart
- Mulch on top



This

Converting turf to water-wise landscape

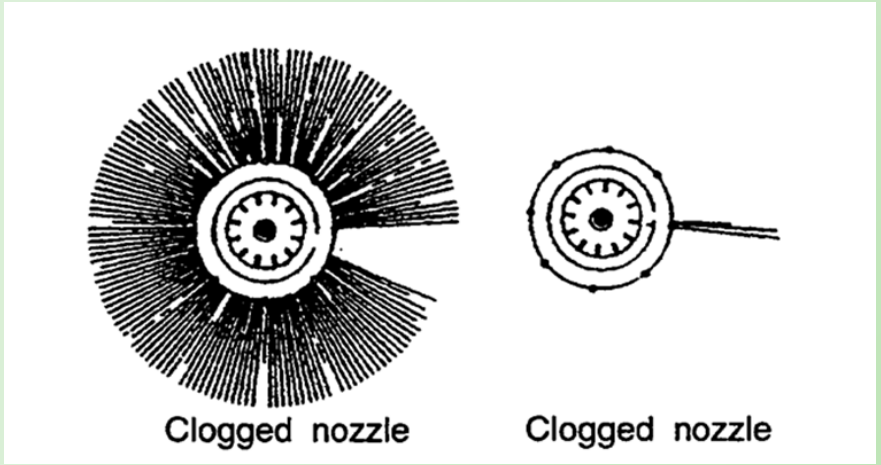
- If you are using bubblers place to irrigate feeder roots, not trunk
- Mulch can be easily washed away
- Schedule irrigation accordingly



Converting turf to water-wise landscape

Spray irrigation

- Avoid runoff
- Avoid hitting tree trunk with water
- Clogging can cause problems



Converting turf to water-wise landscape

Mulch

- Use arborist mulch, with leaves, twigs and chips – decompose faster
- Avoid gorilla hair and wood chips

Summary

- Trees provide many benefits
- Establish a TPZ and defend it
  - This means reviewing the plans
- Irrigate according to tree's needs, where the tree is getting water.
- Avoid burying root collars
- Use arborist mulch

What strategies do you use to protect mature trees?

- Tree Transition Plans
- Sheet mulch (3x); Wood mulch instead of rocks
- Hand digging around tree root zone; Avoid cutting major roots.
- Tree protection fencing; protect roots (4x); Avoid soil compaction around trees.
- Avoid hardscape near root balls
- Soaker hose conversion
- Hydrozoning (4x); water the trees; deep root watering; tree bubblers; test irrigation
- Drip irrigation tree rings (3x); ample water around tree canopy
- Slowly tailor watering schedule
- Avoiding turf rotors spraying trunk and canopy
- Select appropriate understory plants
- WUCOLS
- Avoid over watering new plantings under the dripline
- 6 ft radius around the tree
- Native understory
- Monitor tree health (2x)

Lawn Conversion and Mature Tree Survey

The Department of Water Resources, in collaboration with the California Water Efficiency Partnership and Watershed Progressive are collecting information on lawn conversion with mature trees to further develop best practices. Below is a link to a 3-minute survey. This survey is anonymous with the option to provide contact information.

https://www.surveymonkey.com/r/FYH6KT3

Watering Trees after Lawn Removal

An alternative calculation

1

The Challenge

- Existing calculators use inches, rather than volume
- They rely on canopy and root area to be equivalent
- Result is a frequency and duration that may not be appropriate to the site conditions

Soil Moisture Irrigation Schedule

Irrigation Association

Project	Example Site		Date	
Address	123 Peppertree Place		Auditor	
City, State	Livermore, CA 94550			

Plant Water Requirement		Value		Units	Source
A.	Hydrozone type	Moderate Water Use			field observation
B.	Reference period	31		days	# of days in month
C.	Reference ET [ETo]	7.5		inches	CIMIS weather data
D.	Landscape coefficient [K_L]	0.36		decimal	$K_T \times K_d \times K_{mc}$
	1) Turf or plant factor [K_T or K_p]	0.90			charts & tables
	2) Vegetation density factor [K_d]	0.50			charts & tables
	3) Microclimate factor [K_{mc}]	0.80			charts & tables
E.	Landscape ET [ET_L]	2.70		inches	C x D
F.	Average daily ET_L	0.09		inches	E / B
Sprinkler Performance		**Value**		**Units**	**Source**
G.	Precipitation rate [PR]	0.43		inches	audit or calculation
H.	Distribution Uniformity [DU_{LQ}]	0.8		inches	audit or estimate
I.	Scheduling multiplier [SM]	1.14		inches	equation
Soil Moisture "Bucket"		**Value**		**Units**	**Source**
J.	Soil Category	Loam			field observation
K.	Available water [AW]	0.18		in. / in.	charts & tables
L.	Root zone depth	18.00		inches	field measurement
M.	Plant available water [PAW]	3.24		inches	K x L
N.	Management allowable depletion [MAD]	0.50		decimal	50% for landscapes

HUNTER INDUSTRIES
Built on Innovation®

2

Irrigation Schedule: Frequency Calculation

- F = Irrigation frequency, days
- AWHC = Available Water Holding Capacity, in inches per foot
- RZ = Root zone, in feet
- MAD = Management Allowable Depletion
- ETo = Reference evapotranspiration rate, in inches per day
- Kc = Crop coefficient, decimal

$$F = \frac{AWHC \times RZ \times MAD}{ET_o \times K_c}$$

HUNTER INDUSTRIES
Built on Innovation®

3

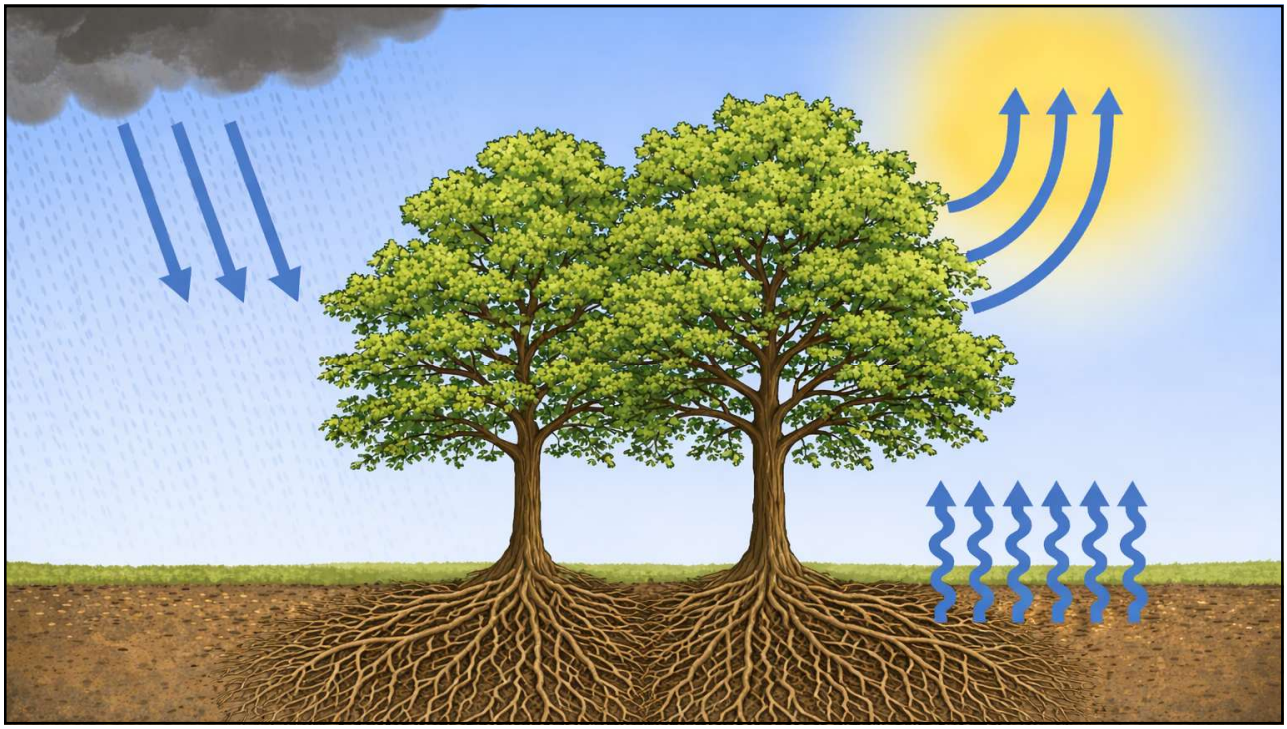
Irrigation Schedule: Duration Calculation

- T = Sprinkler run time in minutes
- 60 = Constant for conversion of area, flow, inches per hour, and inches per day into common units
- D = Watering frequency in days
- ETo = Reference evapotranspiration rate, in inches per day
- Kc = Crop coefficient, decimal
- PR = Precipitation rate of the area, in inches per hour
- IE = Application efficiency of the system, percent

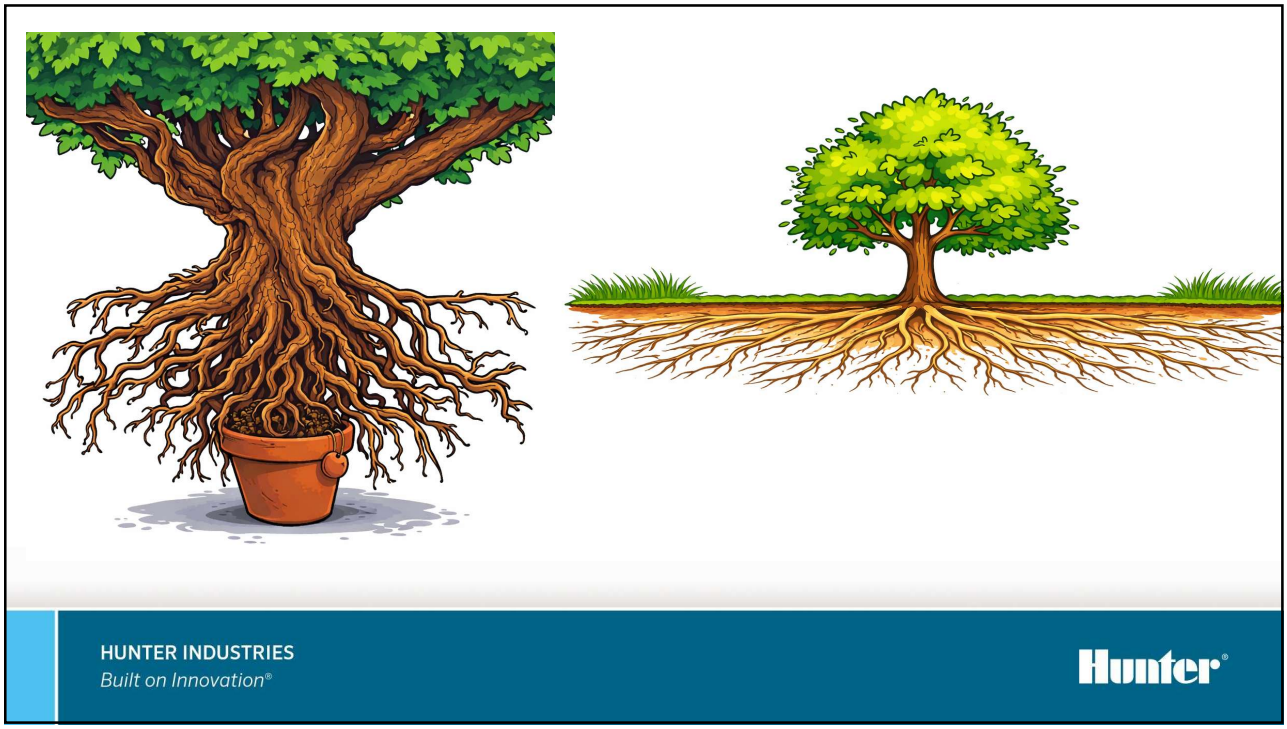
$$T = \frac{60 \times D \times ET_o \times K_c}{PR \times IE}$$

HUNTER INDUSTRIES
Built on Innovation®

4



5



6

Demand
How many gallons are required by the tree canopy?

Storage
How many gallons can be stored in the root zone area?

Supply
How many gallons are supplied by irrigation?

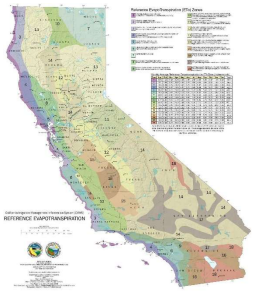
Schedule
What is the irrigation frequency and duration?

HUNTER INDUSTRIES
Built on Innovation®

7

Water Demand

- Evapotranspiration
- Canopy size
- Convert to Gallons

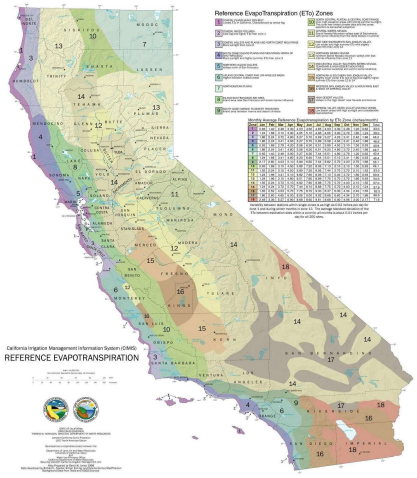


HUNTER INDUSTRIES
Built on Innovation®

8

Evapotranspiration

- Given in a rate of inches over time
  - *i.e.* in./day, in./month
- Data from CIMIS
- According to UCANR SLIDE scheduling method, trees in California use 0.5 of reference ET.

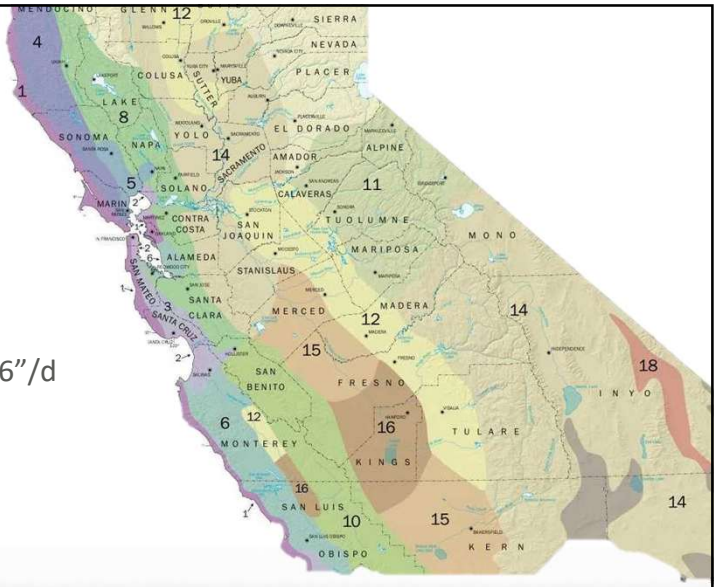


HUNTER INDUSTRIES
Built on Innovation®

9

Example:

- Zone 10
- Peak ETo in July is 8”
- Calculate daily ETo
  - 8”/mo divided by 31 days =0.26”/d
- Calculate tree ETt
  - 0.26”/day x 0.5 = 0.13”/day



HUNTER INDUSTRIES
Built on Innovation®

10

Canopy Size

- Area: $A = \pi r^2$
- Canopy size is suitable for general landscape water requirement calculations
- Leaf Area Index (LAI) is used for detailed hydrological modeling.

HUNTER INDUSTRIES
Built on Innovation®

Hunter®

11

Calculate Gallons

- Use Evapotranspiration and Canopy Size:
  - GALLONS/DAY = INCHES/DAY x SQFT x 0.623
- Example:
  - ET = 0.13”/Day
  - Canopy = 10’ diameter
  - $0.13"/day \times (3.14 \times 5^2)) \times 0.623 = 6.4\ Gallons/Day$

HUNTER INDUSTRIES
Built on Innovation®

Hunter®

12


Demand
6.4 GPD
Storage
Supply
Schedule
HUNTER INDUSTRIES
Built on Innovation®
Hunter®

13


Water Holding Capacity
• Tree roots grow in moist soil
• Soil type
• Determines Available Water Holding Capacity (AWHC), in./ft.
• Soil volume
• Depth x Area
• Used to convert AWHC to gallons
• Managed Allowed Depletion
• MAD of 0.5 is allowed by SLIDE method for all trees in California
HUNTER INDUSTRIES
Built on Innovation®
Hunter®

14

Water Holding Capacity: Soil Type

Soil Type	Total Available Water, in/ft	Gallons AW per Cu.Ft.
Coarse Sand	0.6	0.37
Fine Sand	1.8	1.12
Sandy Clay Loam	1.9	1.18
Loamy Sand	2.0	1.25
Clay Loam	2.2	1.37
Sandy Loam	2.4	1.50
Silty Clay Loam	2.4	1.50
Clay	2.4	1.50
Silty Clay	2.6	1.62
Loam	3.8	2.37
Silt Loam	4.2	2.62
Peat	6.0	3.74

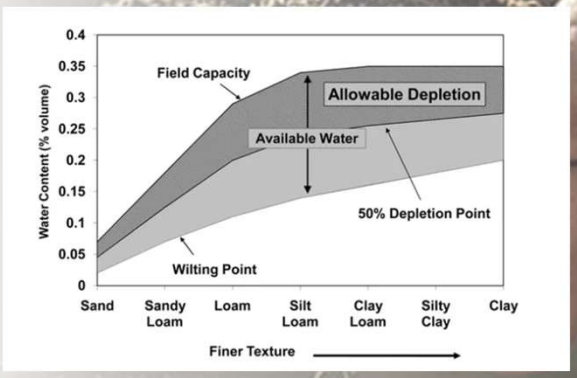


Chart downloaded from https://ucanr.edu/

Water Holding Capacity: Soil Volume

- Determine root zone
  - Area
  - Depth
- Available Gallons: AWHC and Root Zone Volume
  - AWHC x Depth x Area x 7.48 = Gallons Available
  - Watch the Units!

Water Holding Capacity: Example with MAD

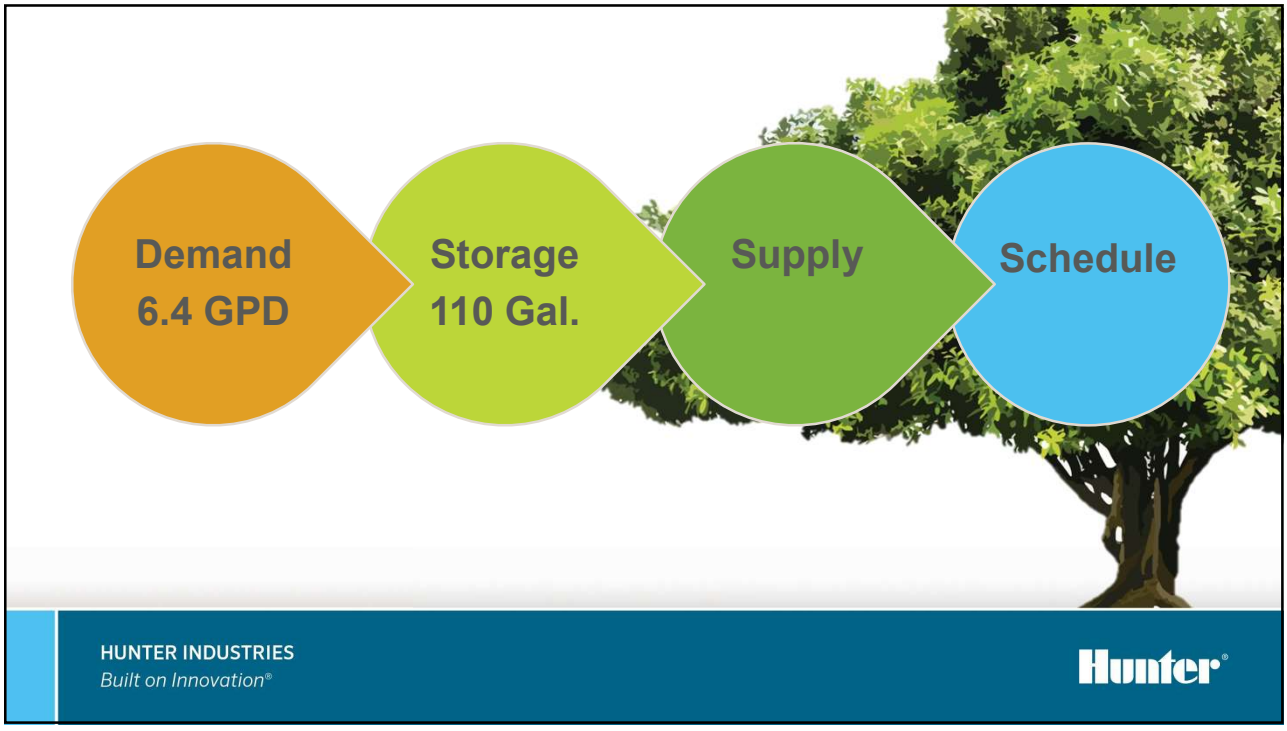
Example:

- Root zone: 15’ diameter, 12” deep
- Soil type: Loamy Sand, AWHC 2”/ft

Equation:

- Gallons Available = AWHC x Depth x Area x 7.48
- Gal = (2in/ft x 12in)/ 144sqin/sqft x (3.14 x (15ft/2)^2)) x 7.48 = 220 Gallons
- MAD: 220 x 0.5 = 110 gallons

17



18

Water Supply

- Irrigation System
  - Precipitation Rate
  - Flow Rate
- Irrigation Schedule
  - Frequency and Duration
  - Determined by water demand and allowed depletion
  - Modify by site and observation

19

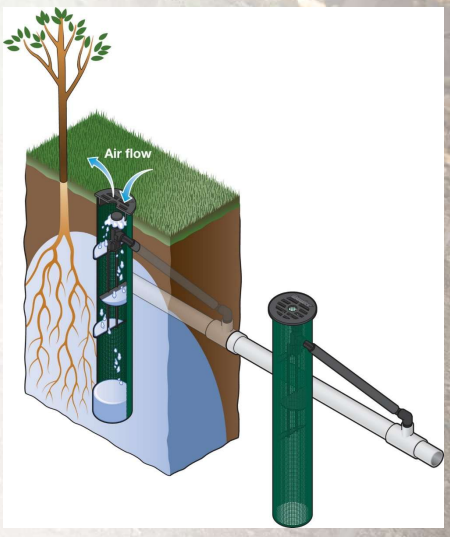
Irrigation Systems

- Irrigation Type
  - Drip
  - Bubbler
  - Overhead
  - Other?

20

Flow Rate

- Calculate based on manufacturer spec, spacing, and area
- Measure from flow sensor or sub meter



HUNTER INDUSTRIES
Built on Innovation®

21

Total Flow: Drip emitters on grid spacing

- F_Z = Total Zone Flow (gallons per minute)
- Q_E = Emitter Flow Rate (gallons per hour)
- A = Area (square feet)
- E_S = Emitter Spacing (inches)
- E_R = Row Spacing (inches)

$$F_Z = \frac{2.4 \times Q_E \times A}{E_S \times E_R}$$

HUNTER INDUSTRIES
Built on Innovation®

22

Total Flow: Drip emitters on grid spacing

- Example Drip System:
  - 0.6 GPH
  - Emitters: 12”
  - Rows: 12”
  - Area: 15’ diameter

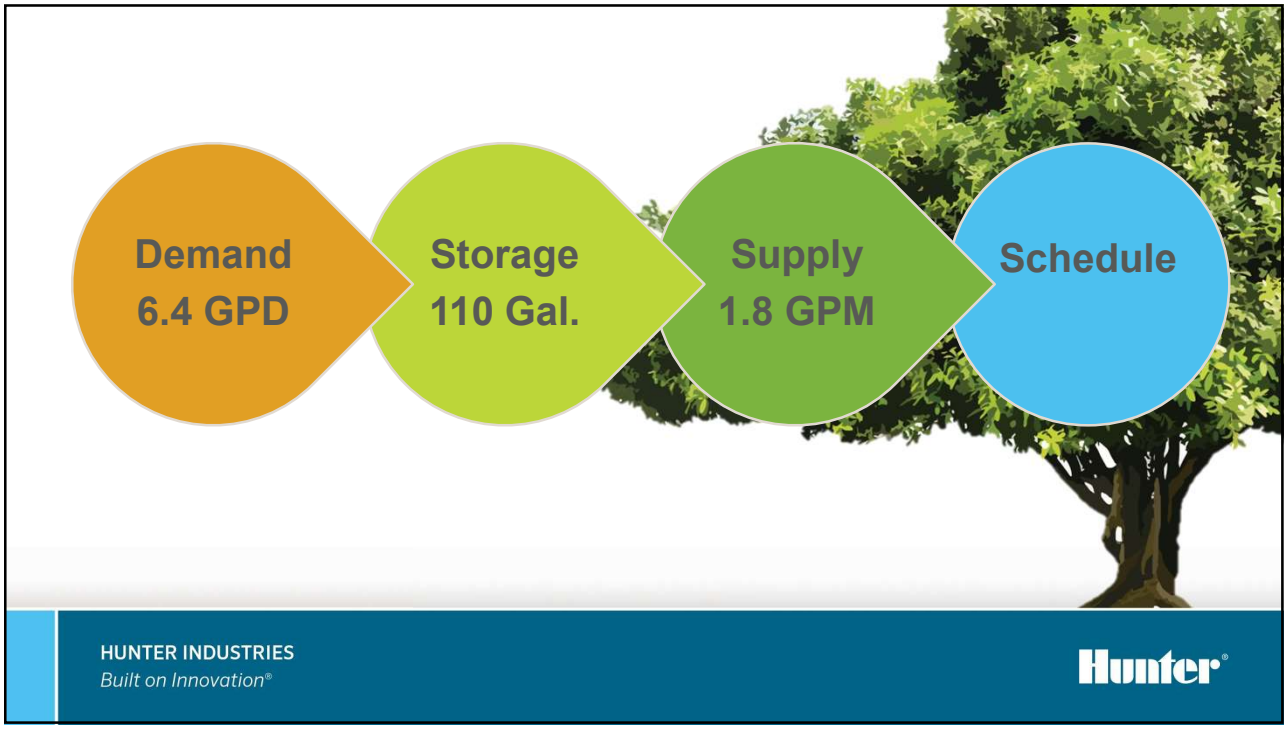
$$F_Z = \frac{2.4 \times Q_E \times A}{E_S \times E_R}$$

- $= \frac{2.4 \times 0.6 \times (3.14 \times (15/2)^2)}{12 \times 12}$
- $= \frac{2.4 \times 0.6 \times 176.6}{144}$
- $= 1.8\ GPM$

HUNTER INDUSTRIES
Built on Innovation®

Hunter®

23



HUNTER INDUSTRIES
Built on Innovation®

Hunter®

24

Irrigation Schedule: Volumetric

- Frequency is decided by gallons required and allowed depletion available OR by user setting.
- Duration is based on zone flow rate, rather than precipitation rate and efficiency estimates.

HUNTER INDUSTRIES
Built on Innovation®

Hunter®

25

Irrigation Schedule: Volumetric

- **Frequency** is decided by gallons required and allowed depletion available OR by user setting.
- Duration is based on zone flow rate, rather than precipitation rate and efficiency estimates.

- Example: Frequency
  - MAD: 110 gallons
  - Daily requirement: 6.4 gallons
  - Frequency: 110/6.4 = 17 days
  - OR: User chooses 14 days

HUNTER INDUSTRIES
Built on Innovation®

Hunter®

26

Irrigation Schedule: Volumetric

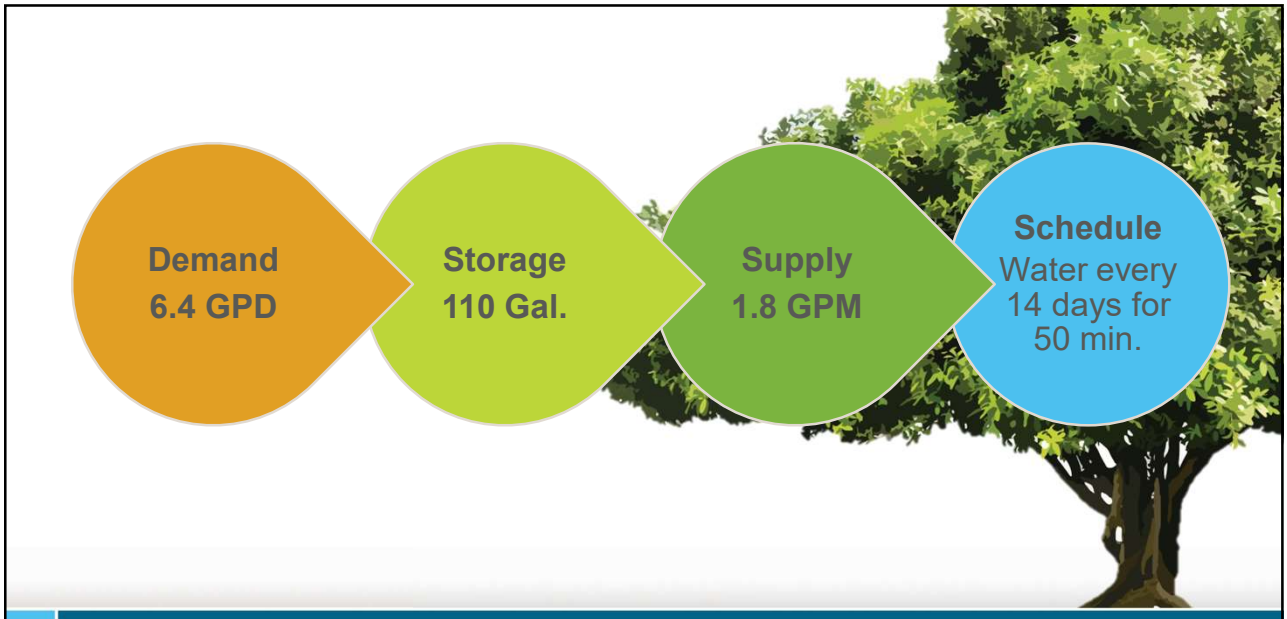
- Frequency is decided by gallons required and allowed depletion available OR by user setting.
- **Duration** is based on zone flow rate, rather than precipitation rate and efficiency estimates.

- Example: Duration
  - Frequency is 14 days
  - Daily requirement is 6.4 gpd
  - Total req'd = 14 x 6.4 = 90 gal
  - If flow rate is 1.8GPM, then total minutes is:
    - 90 gal / 1.8 GPM = 50 minutes

HUNTER INDUSTRIES
Built on Innovation®

Hunter®

27



HUNTER INDUSTRIES
Built on Innovation®

Hunter®

28

Irrigation Schedule: Frequency, by volume

- F = Irrigation frequency, days
- AWHC = Available Water Holding Capacity, in inches per foot
- RZ_D= Root zone depth, inches
- RZ_A= Root zone area, square feet
- MAD = Management Allowable Depletion
- ET_O = Reference evapotranspiration rate, in inches per day
- K_C = Crop coefficient, decimal
- C_A = Canopy Area, square feet

$$F = \frac{RZ_D \times RZ_A \times AWHC \times MAD}{ET_o \times K_c \times C_A \times 12}$$

HUNTER INDUSTRIES
Built on Innovation®

29

Irrigation Schedule: Duration, by volume

- T = Sprinkler run time in minutes
- 0.62 = Constant for conversion
- F = Watering frequency in days
- ET_O = Reference evapotranspiration rate, in inches per day
- K_C = Crop coefficient, decimal
- C_A = Canopy Area, square feet
- Q = Flow rate, GPM

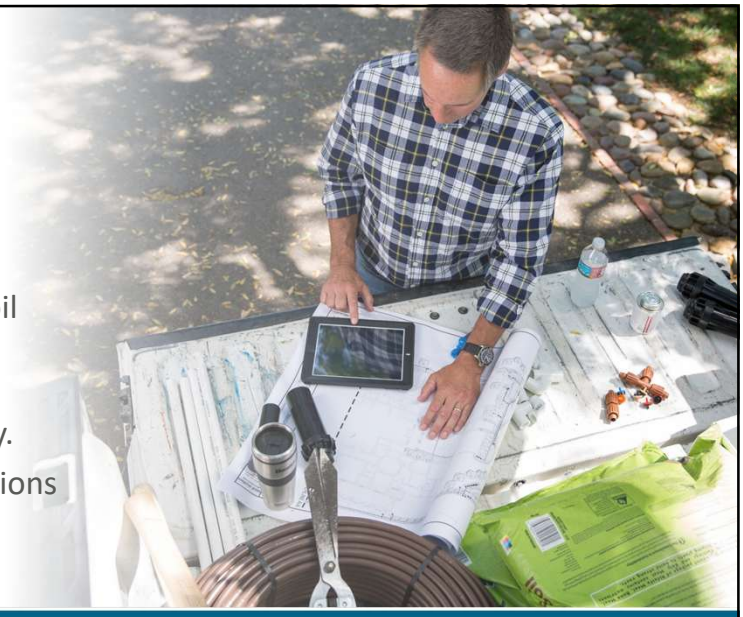
$$T = \frac{0.62 \times \mathrm{F} \times ET_o \times K_c \times C_A}{\mathrm{Q}}$$

HUNTER INDUSTRIES
Built on Innovation®

30

Tips and Tricks

- Expect trees to suffer more in drought conditions.
- Properly hydrate the entire soil profile prior to massive renovations.
- Allow plants to recover, slowly.
- Key to success is site observations and managed adjustments.



HUNTER INDUSTRIES
Built on Innovation®

Hunter®

31

HUNTER INDUSTRIES
Built on Innovation®

Hunter®

32

Thank you!

33

Thank you!

Kristin.Bowman@ebmud.com

Lindsay.Kinsler@ebmud.com

Darya Barar, dbarar@bartlett.com

Christine.Hawkins@hunter.global

Chris.McNairy@hunter.global