Welcome to virtual meeting: Putting weekly crop ET reports to work for you

About this meeting:

1. This event will be recorded for educational or promotional use by the University of California.
2. Your mic will be muted by default to prevent background noise. We ask all participants to remain muted.
3. Please type questions or discussion responses in the Chat box.

Putting Weekly Crop ET Reports to Work For You

From a soil perspective

Tutorial #2
Tuesday April 21, 2020

Allan Fulton
UC Irrigation and Water Resources Advisor
Tehama, Glenn, Colusa, and Shasta Counties

Previous Tutorial #1- April 3, 2020

Topics:

1. Basic ET Concepts
2. How to read report tables?
3. How to pick irrigation efficiency factor?
4. How to convert ET estimates from inch per acre to gallons per tree or vine?
5. How to calculate irrigation set run time?
   - In relation to irrigation system design and efficiency

- Video link
  - https://www.youtube.com/watch?v=1snOHbS5nWk
- PPt link
  - https://ucanr.edu/sites/PSU/files/323405.pdf

This tutorial #2

Topics – Using weekly Crop ET reports from a soils perspective

1. Why consider the soils perspective?
2. What is water budgeting and how is ETc part of it?
3. Using a water budget to track soil moisture depletion in your orchard
4. Pairing a water budget with soil moisture monitoring
5. How to adjust for different irrigation wetting patterns

Why consider the soils perspective?

- Soils store water from the rainy seasons for use during the growing season
- It may or may not be a substantial part of the seasonal crop water demand
  - Depends on crop root zone, soil characteristics, and amount of rainfall
- Soils control how water infiltrates and percolates through soil which, in turn, affects soil aeration and crop root health
- Irrigating according to ET without consideration of the soils increases the chance of over-irrigation

What is water budgeting?

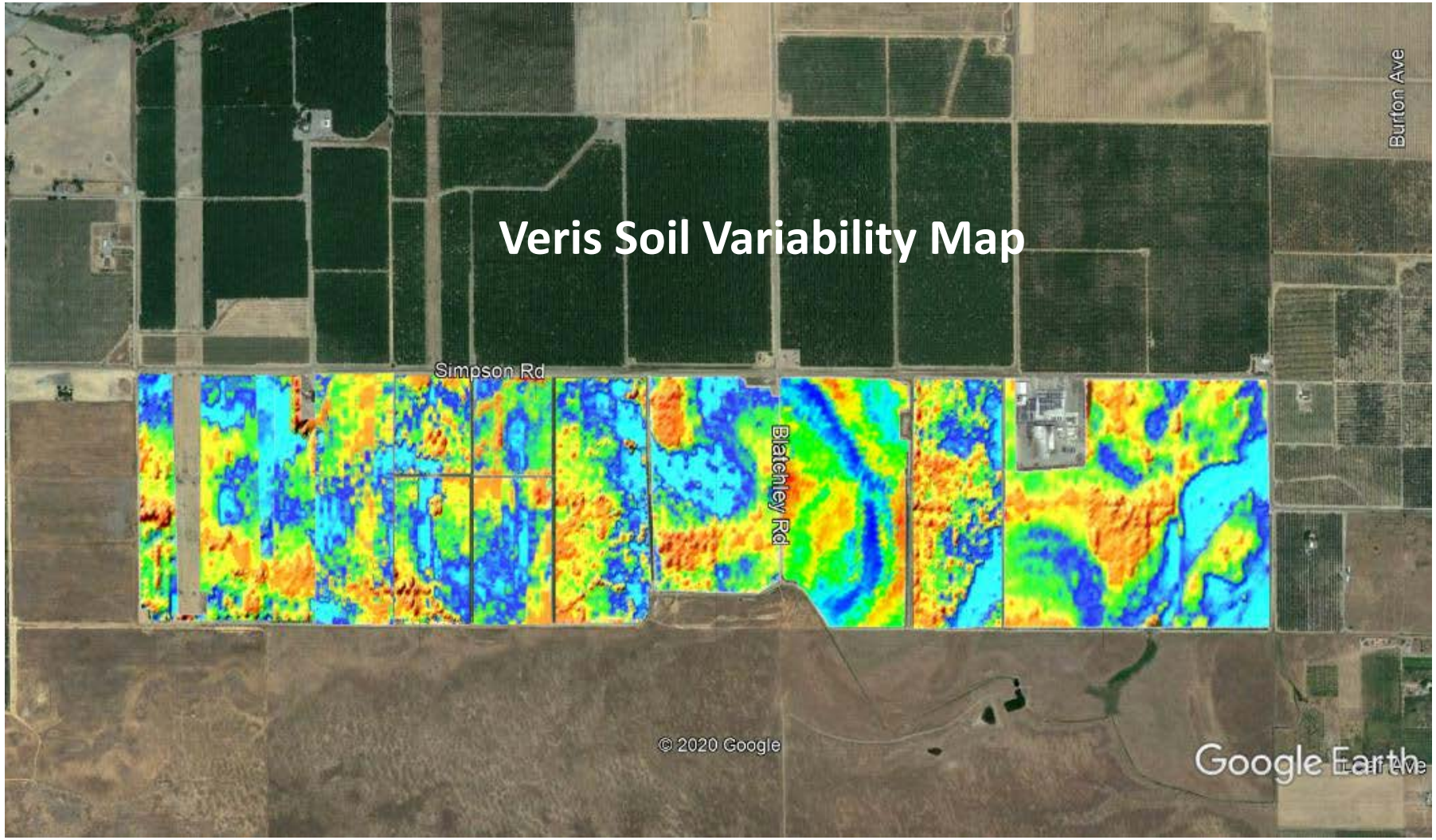
- An accounting of the crop water demand (ET_c) and all water supplied
- Weekly ET reports inform the water demand side of a water budget
- Looking for a balance not a surplus or overdraft
- A method of estimating and tracking soil moisture depletion
  - Over-supply, soils too wet
  - Under-supply, soils too dry
  - Striking a balance best chance for sustainable crops

Why use a water budget to estimate soil moisture depletion?

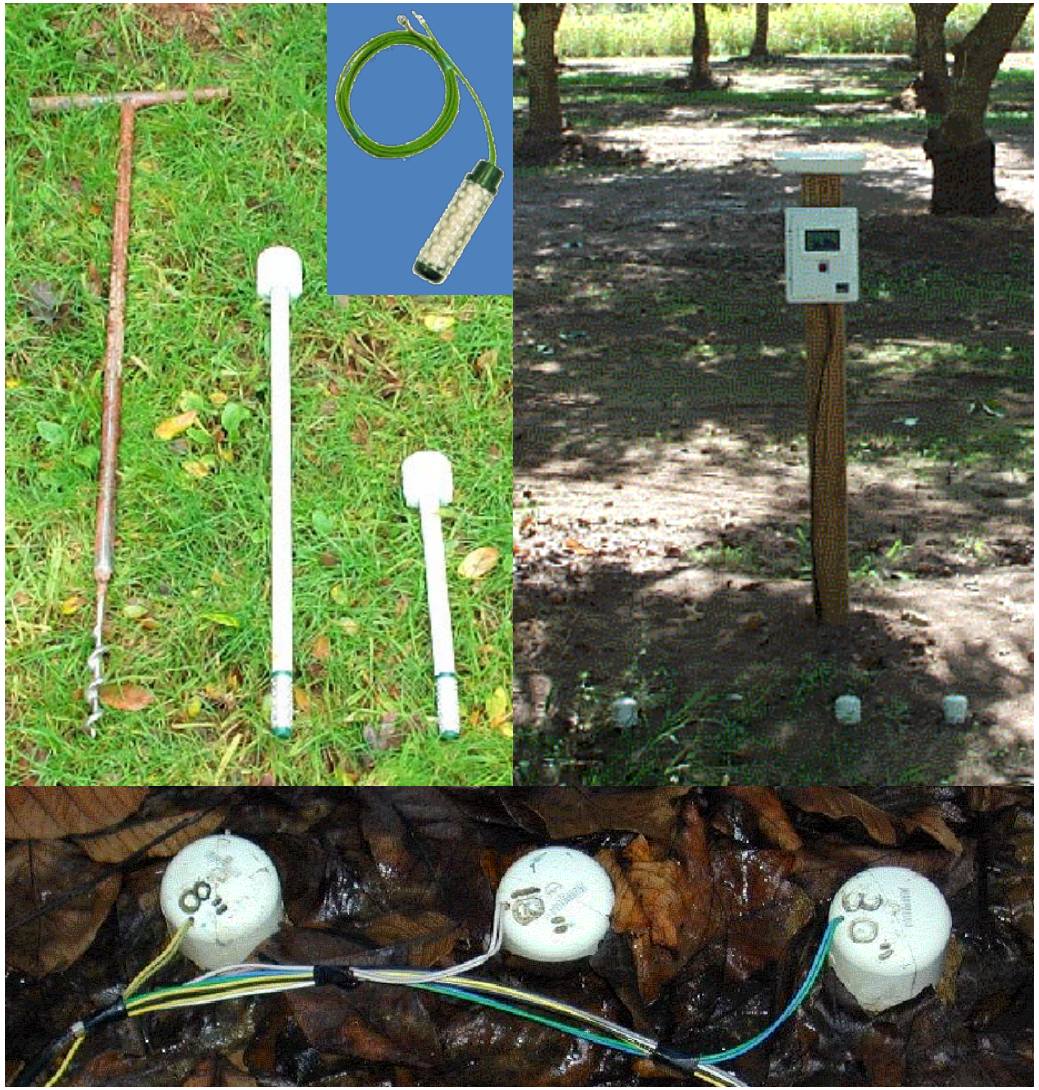
1. If incorporating science-based information into irrigation management is new, using a water budget is a good place to begin.
2. Inexpensive on-farm irrigation management approach
3. A way to estimate and anticipate soil moisture conditions and irrigation needs (plan ahead)
4. A “budget” lends itself to tracking and reporting irrigation management practices
5. Offers a ranch or field-wide picture of irrigation management

The ranch or field-wide picture of soil variability

The ranch or field-wide picture of soil variability



In terms of scale, estimating soil moisture depletion using an ET-based water budget is a sharp contrast to actual soil moisture monitoring



Knowledge Check #1

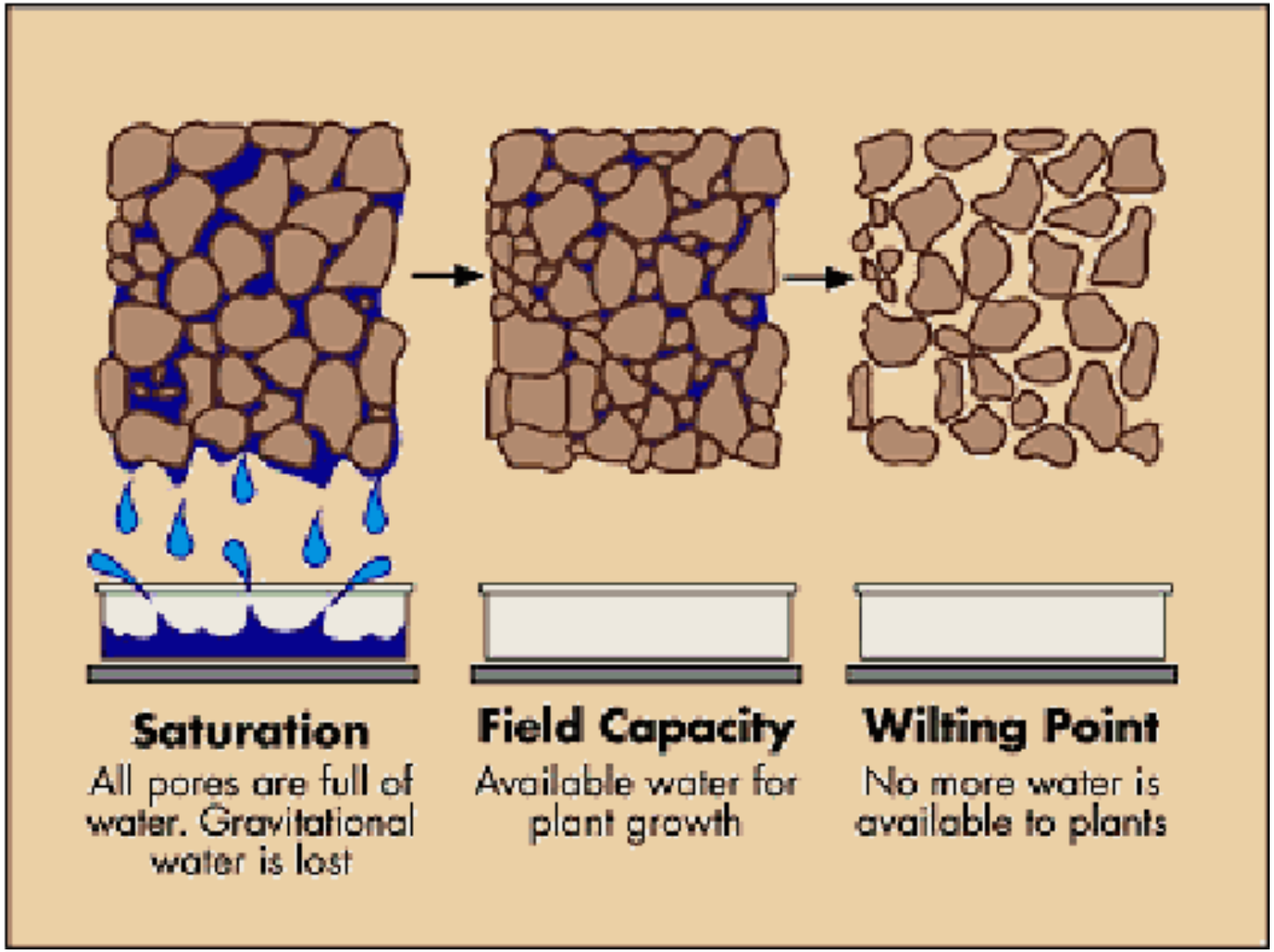
What is a water budget and how might one help with irrigation management?

Step 1:

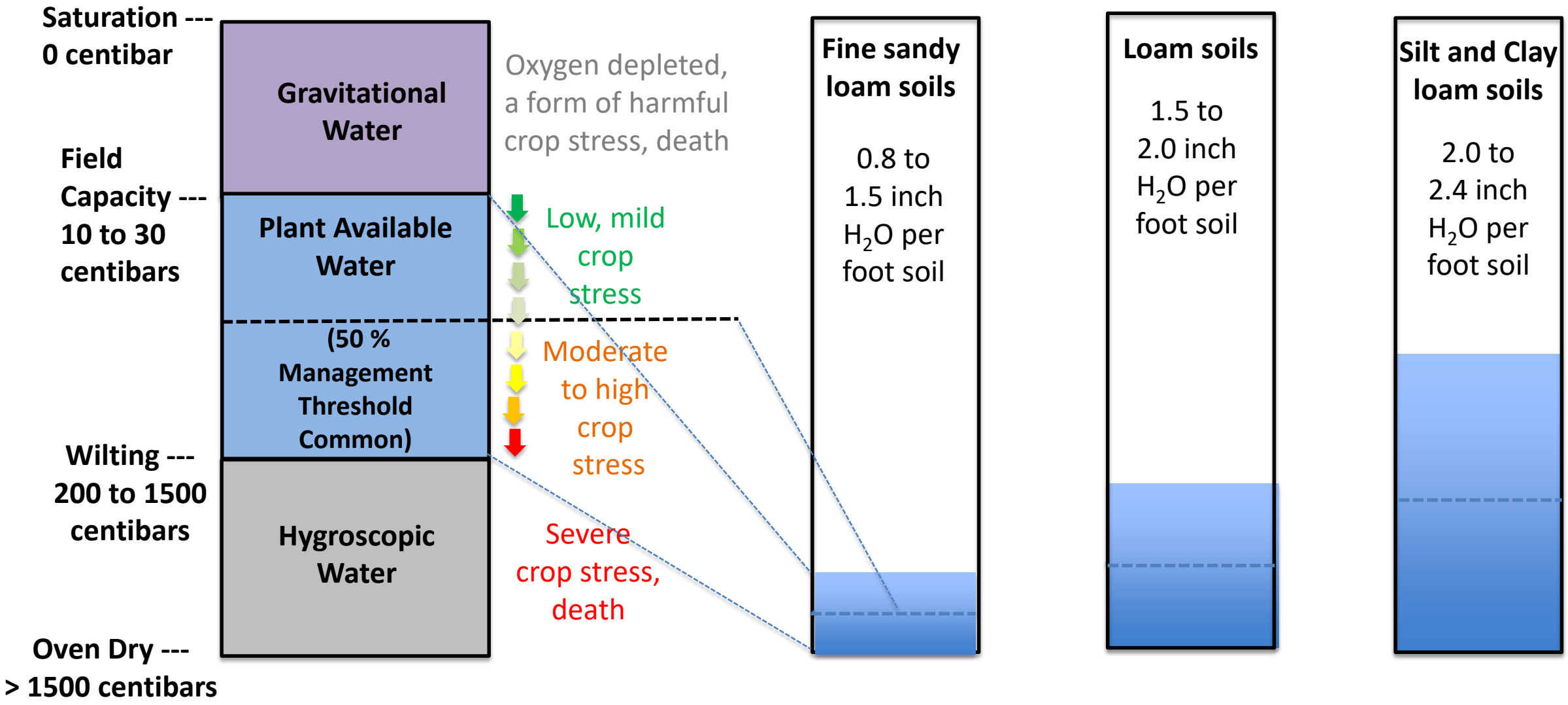
To perform a water budget, the water holding capacity of the orchard soil must be assessed.

Depends on site specific soil characteristics

Saturated and unsaturated soils



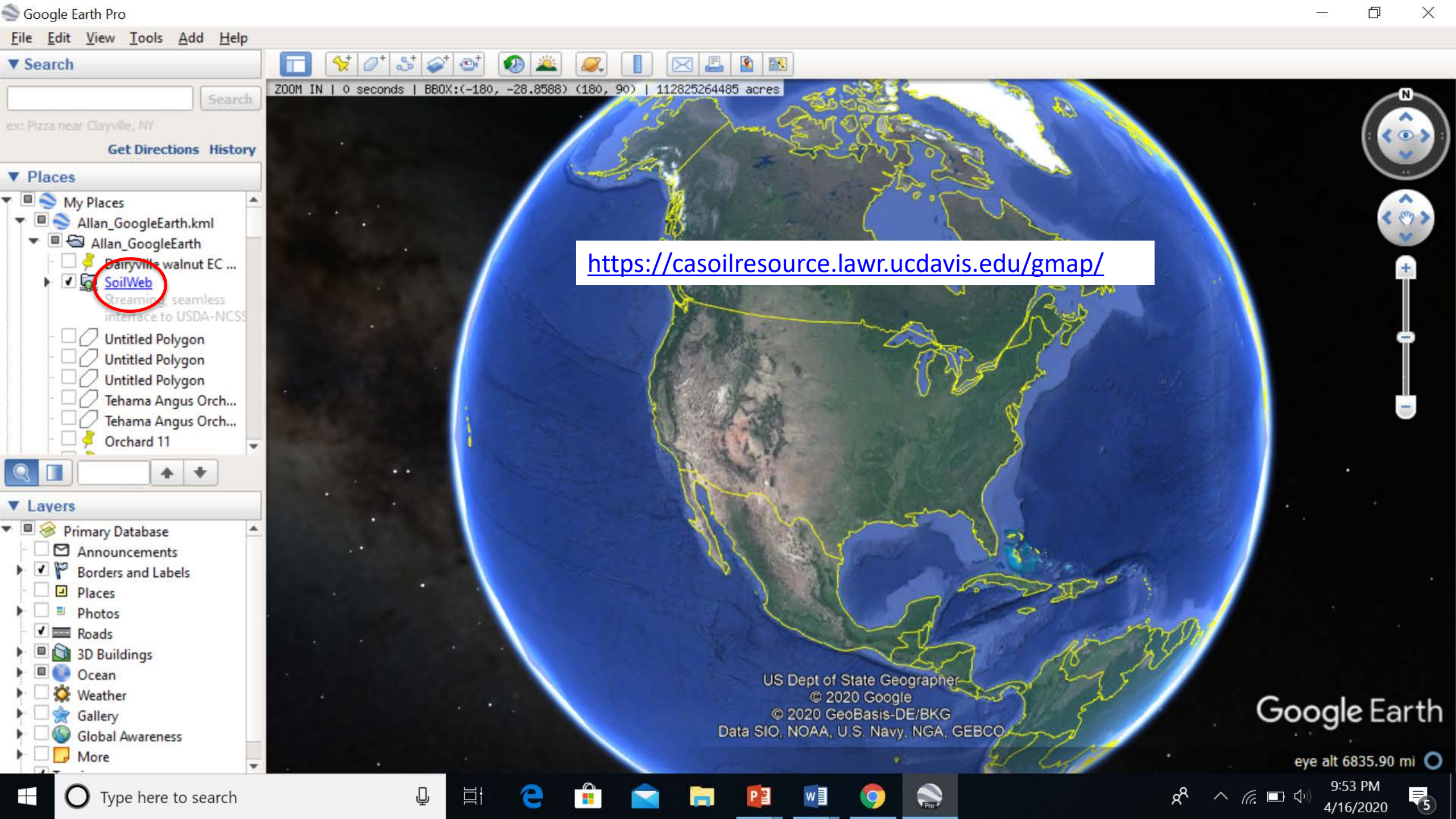
Soil Water Holding Capacity Concepts



Approximate water holding capacity of soils based upon soil texture

Soil Texture	Field capacity	Unrecoverable Wilting	Plant Available Water Capacity
	(Inches/ft of soil)		
Sandy loam	1.8	0.6	1.2
Fine sandy loam	2.4	0.9	1.5
Loam	3.0	1.2	1.8
Silt loam	3.4	1.4	2.0
Clay loam	3.8	1.6	2.2
Clay	4.0	2.0	2.0

Source: Field Irrigation Management in a Nutshell. Table 1. Free online UC ANR publication 8571. Daniele Zaccaria, 2019.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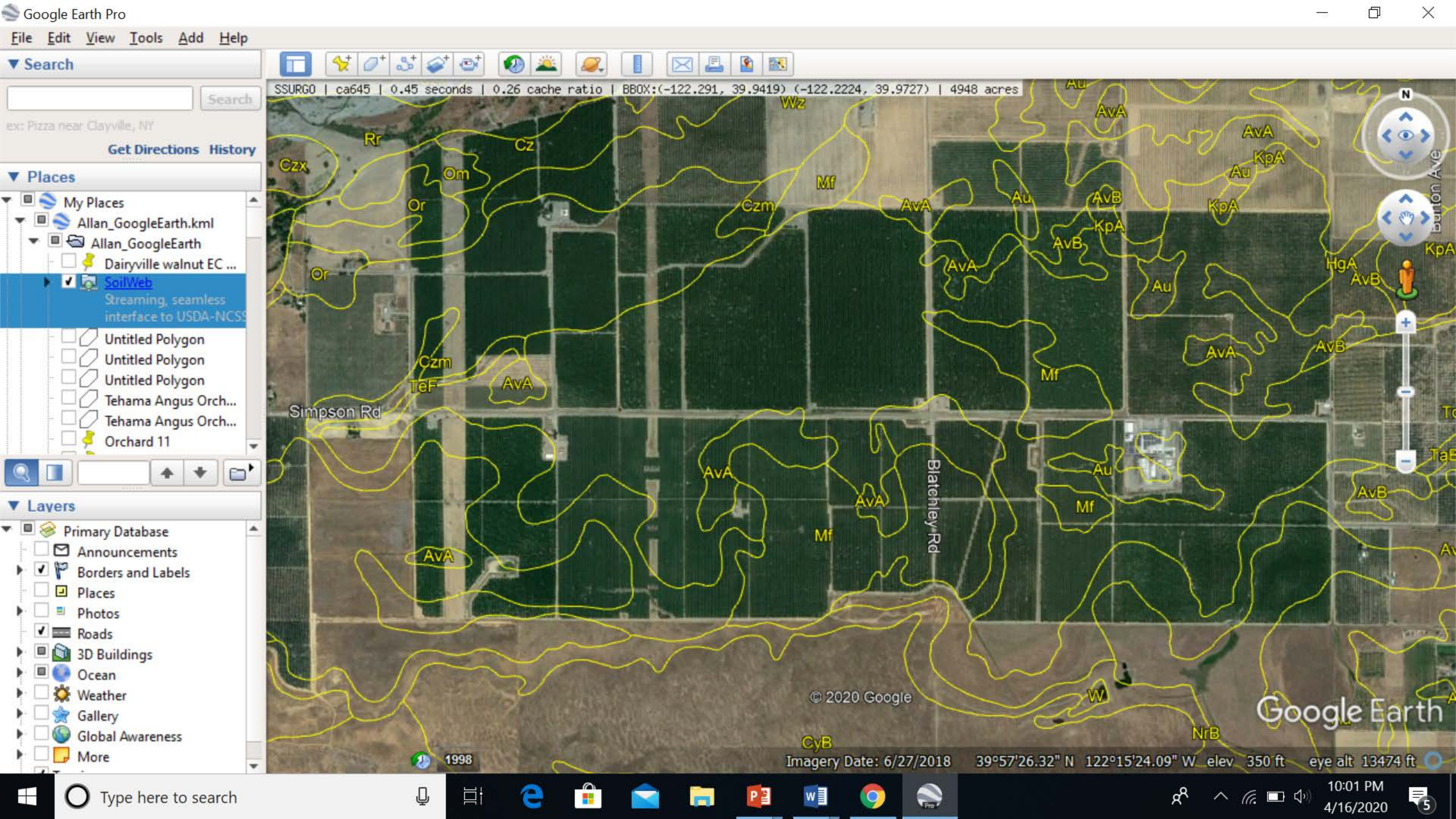
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Tehama silt loam, 0 to 3 percent slopes, gravelly substratum, MLRA 17 (SSURGO Export: 2019-09-16)

Components within map unit 2766098

Tehama (85%)
Typic Haploxeralfs

terraces

Wz Rr Cz Czx Om Or Mf Czm Or Czm TeF AvA Simpson Rd AvA Mf AvA CyB W NrB HgA AvB KpA AvB AvB

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https://casoilresource.lawr.ucdavis.edu/soil_web/ssurgo.php - SoilWeb

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Map Unit Composition

Map units consist of 1 or more soil types, commonly referred to as "components".

Component Name	Geomorphic Position	Area Fraction	Component Type	Horizon Data
Soil Type 1 **Tehama**	terraces	85%	Major Soil Type	YES
Soil Type 2 **Hillgate**		5%	Inclusion	Similar Data [5] *
Soil Type 3 **Arbuckle**		5%	Inclusion	Similar Data [4] *
Soil Type 4 **Plaza**		5%	Inclusion	None

*Note: links to horizon data marked with an * are approximate.*

Map Unit Data What is a Map Unit?

Cartographic information about this map unit.

Map Unit Name:	Tehama silt loam, 0 to 3 percent slopes, gravelly substratum, MLRA 17
Map Unit Type:	Consociation
Map Unit Symbol:	Tc
Map Unit Area:	acres (8724ac. total in survey area)

Raw Map Unit Data

Raw Component Data (All Components)

Map Unit Aggregated Data

Generalized soils information within this map unit.

Farmland Class:	Prime farmland if irrigated
Available Water Storage (0-100cm):	17.72 cm
Max Flood Freq:	None
Drainage Class (Dominant Condition):	Well drained
Drainage Class (Wettest Component):	Well drained
Hydric Conditions:	0
[Annual] Min. Water Table Depth:	n/a
[April-June] Min. Water Table Depth:	n/a
Min Bedrock Depth:	n/a

Raw Aggregated Map Unit Data

Associated Point Data

Conversions:

1. 17.72 cm H_2O ÷ 2.54 cm/inch = 7.0 inches H_2O
2. 100 cm soil ÷30 cm/foot = 3.3 feet soil
3. 7.0 inches water ÷3.3 feet soil = 2.1 inch H_2O/foot soil

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Arbuckle gravelly loam, 0 to 2 percent slopes, MLRA 17 (SSURGO Export: 2019-09-16)

Components within map unit 460686

Arbuckle (85%)
Typic Haploxeralfs

A1	0 cm
A2	13 cm
A3	25 cm
Bt1	43 cm
Bt2	66 cm
Btk	86 cm
BCk	112 cm
	173 cm

stream terraces / Toeslope

Block Diagrams: c/o NCSS Job Aids
note that these diagrams may be from multiple survey areas

Wz Rr Cz Czx Om Or Or Czm TeF AvA Simpson Rd AvA Au AvA KpA Au AvB KpA AvB KpA Au HgA AvB KpA AvA AvB Mf Au AvB Mf W NrB Burton Ave

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Imagery Date: 6/27/2018 39°57'16.83" N 122°16'04.62" W elev 374 ft eye alt 13474 ft

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Map Unit Composition

Map units consist of 1 or more soil types, commonly referred to as "components".

Component Name	Geomorphic Position	Area Fraction	Component Type	Horizon Data
Soil Type 1 **Arbuckle**	stream terraces / Toeslope	85%	Major Soil Type	YES
Soil Type 2 **Cortina**		5%	Inclusion	Similar Data [3] *
Soil Type 3 **Maywood**		5%	Inclusion	Similar Data [6] *
Soil Type 4 **Hillgate**		5%	Inclusion	Similar Data [5] *

*Note: links to horizon data marked with an * are approximate.*

Map Unit Data What is a Map Unit?

Cartographic information about this map unit.

Map Unit Name:	Arbuckle gravelly loam, 0 to 2 percent slopes, MLRA 17
Map Unit Type:	Consociation
Map Unit Symbol:	AvA
Map Unit Area:	acres (17454ac. total in survey area)

Raw Map Unit Data

Raw Component Data (All Components)

Map Unit Aggregated Data

Generalized soils information within this map unit.

Farmland Class:	Prime farmland if irrigated
Available Water Storage (0-100cm):	13.64 cm
Max Flood Freq:	None
Drainage Class (Dominant Condition):	Well drained
Drainage Class (Wettest Component):	Well drained
Hydric Conditions:	0
[Annual] Min. Water Table Depth:	n/a
[April-June] Min. Water Table Depth:	n/a
Min Bedrock Depth:	n/a

Raw Aggregated Map Unit Data

Associated Point Data

Links to any NSSL point data within this map unit.

Conversions:

1. 13.64 cm H_2O ÷ 2.54 cm/inch = 5.3 inches H_2O
2. 100 cm soil ÷30 cm/foot = 3.3 feet soil
3. 5.4 inches water ÷3.3 feet soil = 1.6 inch H_2O/foot soil

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Step 2: What is the effective root zone of a perennial tree crop?

- Lots of observations and opinions
- Less quantitative data
- Certainly deeper than can be evaluated quickly with a shovel
- Fulton suggests using at least four feet for three year old trees and older
- UC ANR Pub 8571 suggests eight feet
- Some California experiences suggest root systems can be ten feet or deeper

Example estimation of plant available water holding capacity

What is the plant available water holding capacity for Orchard A1 with a 50 percent management threshold?

- A1 walnut orchard is growing on the Tehama silt loam soil series with available water storage capacity of **2.1 inches per foot soil**. The effective root zone is estimated to be 7 **feet**.

A1 Orchard:

1. 7 foot root zone x 2.1 inch/ft = 14.7 inches
2. 14.7 inches total plant available H_2O
3. 14.7 inches x 0.50 = 7.4 inches at 50 percent management threshold

Knowledge Check #2

What is the plant available water holding capacity for orchard A2 with a 50 percent management threshold?

1. A2 almond orchard is growing on Arbuckle gravelly loam with available water storage capacity of **1.6 inches per foot soil**. The effective root zone is estimated to be **4 feet**.

Review Knowledge Check #2

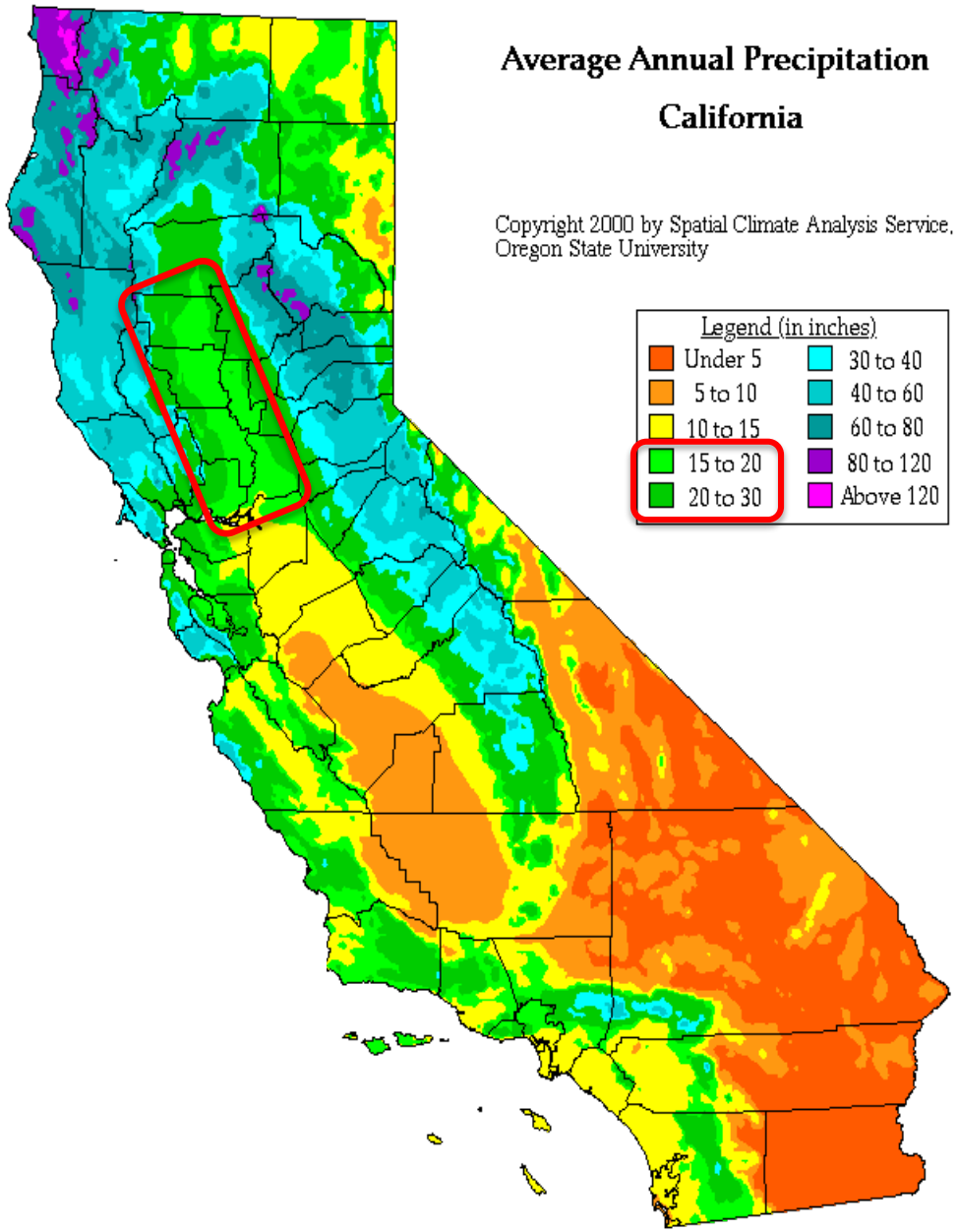
What is the plant available water holding capacity for orchard A2?

- A2 almond orchard is growing on Arbuckle gravelly loam with available water storage capacity of **1.6 inches per foot soil**. The effective root zone is estimated to be **4 feet**.

A2 Orchard:

1. 4 foot root zone x 1.6 inch/ft = 6.4 inches
2. 6.4 inches total plant available H_2O
3. 6.4 inches x 0.50 = 3.2 inches at 50 percent management threshold

Will the orchard root zone will be refilled at the start of each new season?



Monitoring Soil Moisture Depletion and Refill – Feel Method

(For Reference, Google: USDA, Estimating Soil Moisture)

Sandier → More Silt → More Clay

Wetter ↓ Drier

Example – Connecting ET_c with Soil Water Availability

WEEKLY ET REPORT

(Estimated Crop Evapotranspiration or ETc)

04/10/20 through 04/16/20

Crops (Leafout Date)	Tehama County - Gerber South			Butte County - Biggs			Butte County - Durham			Colusa County - Williams		
	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc
Almonds (3/1) *	1.11	3.90	0.96	1.06	3.65	0.87	1.01	3.41	0.89	1.20	4.35	0.80
Past 7 days precipitation (inches)		(0.00)			(0.00)			(0.00)			(0.00)	
Accumulated precipitation (inches)		(2.66)			(1.37)			(2.18)			(0.52)	

When might I apply the first irrigation?

A2 Orchard Available Water Threshold:

1. 4 foot root zone x 1.6 inch/ft = 6.4 inches
2. 6.4 inches total plant available H_2O
3. 6.4 inches x 0.50 = 3.2 inches at 50 percent management threshold

Thought Process (Orchard located in Tehama County):

1. 3.2 inches available H_2O at 50 percent management threshold
2. 3.90 inches accum'd seasonal water use
3. 2.66 inches accum'd rainfall x 50 % (effective) = 1.33 inches
4. The Math:
   - 3.2" available - 3.9" ETc + 1.33" Rain =
   - 3.2" – 3.9" + 1.3" = 0.6" until 50 percent depletion
5. MIGHT I WAIT ANOTHER WEEK TO BEGIN IRRIGATING? IF NOT, HOW MUCH WATER MIGHT I APPLY?

Knowledge check #3

In your estimation, if orchard A1 were located in Colusa County (Williams) instead of Tehama County (Gerber), would it be time to begin irrigation?

Knowledge check #3 - Review

WEEKLY ET REPORT

(Estimated Crop Evapotranspiration or ETc)

04/10/20 through 04/16/20

Crops (Leafout Date)	Tehama County - Gerber South			Butte County - Biggs			Butte County - Durham			Colusa County - Williams		
	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc	Past Week of Water Use	Accum'd Seasonal Water Use	Next Week's Estimated ETc
Almonds (3/1) *	1.11	3.90	0.96	1.06	3.65	0.87	1.01	3.41	0.89	1.20	4.35	0.80
Past 7 days precipitation (inches)		(0.00)			(0.00)			(0.00)			(0.00)	
Accumulated precipitation (inches)		(2.66)			(1.37)			(2.18)			(0.52)	

When might I apply the first irrigation?

A2 Orchard Available Water Threshold:

1. 4 foot root zone x 1.6 inch/ft = 6.4 inches
2. 6.4 inches total plant available H_2O
3. 6.4 inches x 0.50 = 3.2 inches at 50 percent management threshold

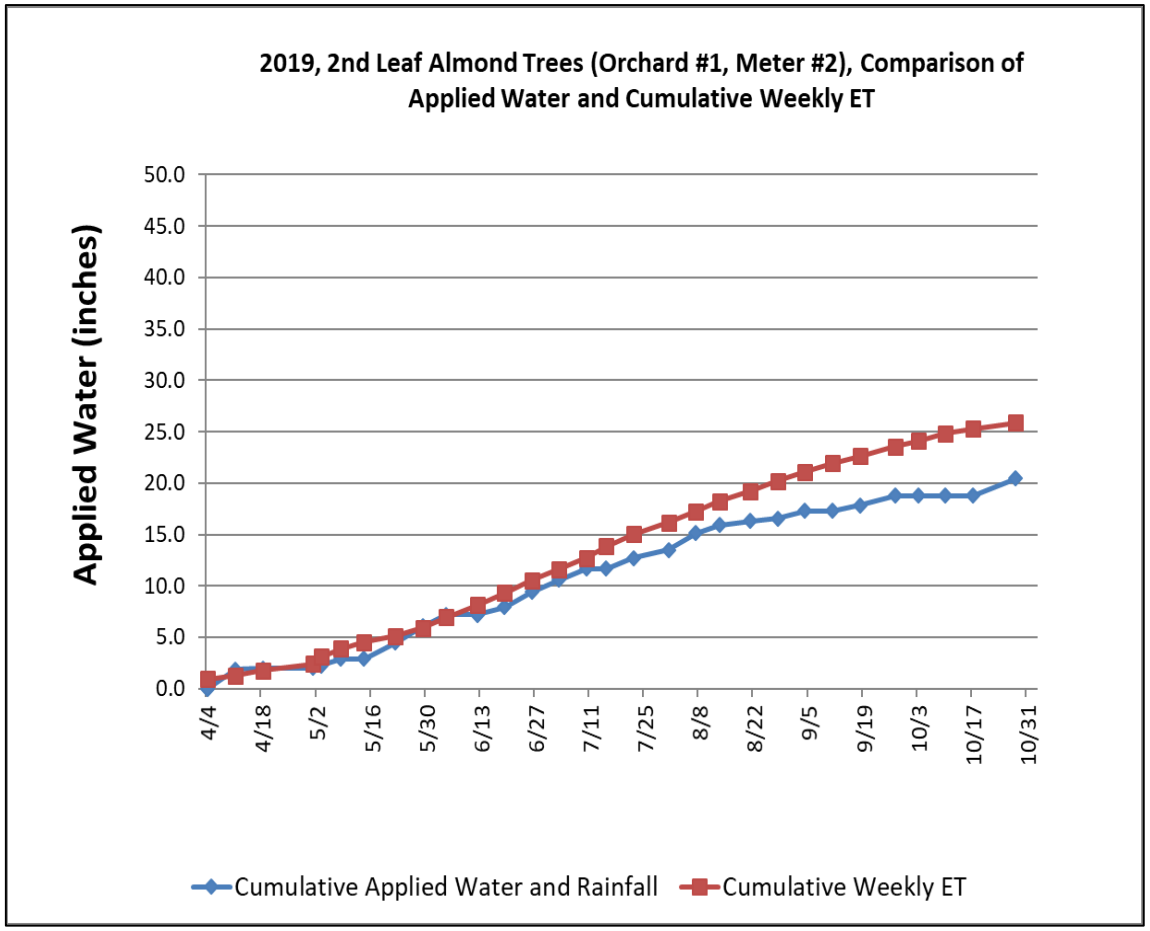
Thought Process:

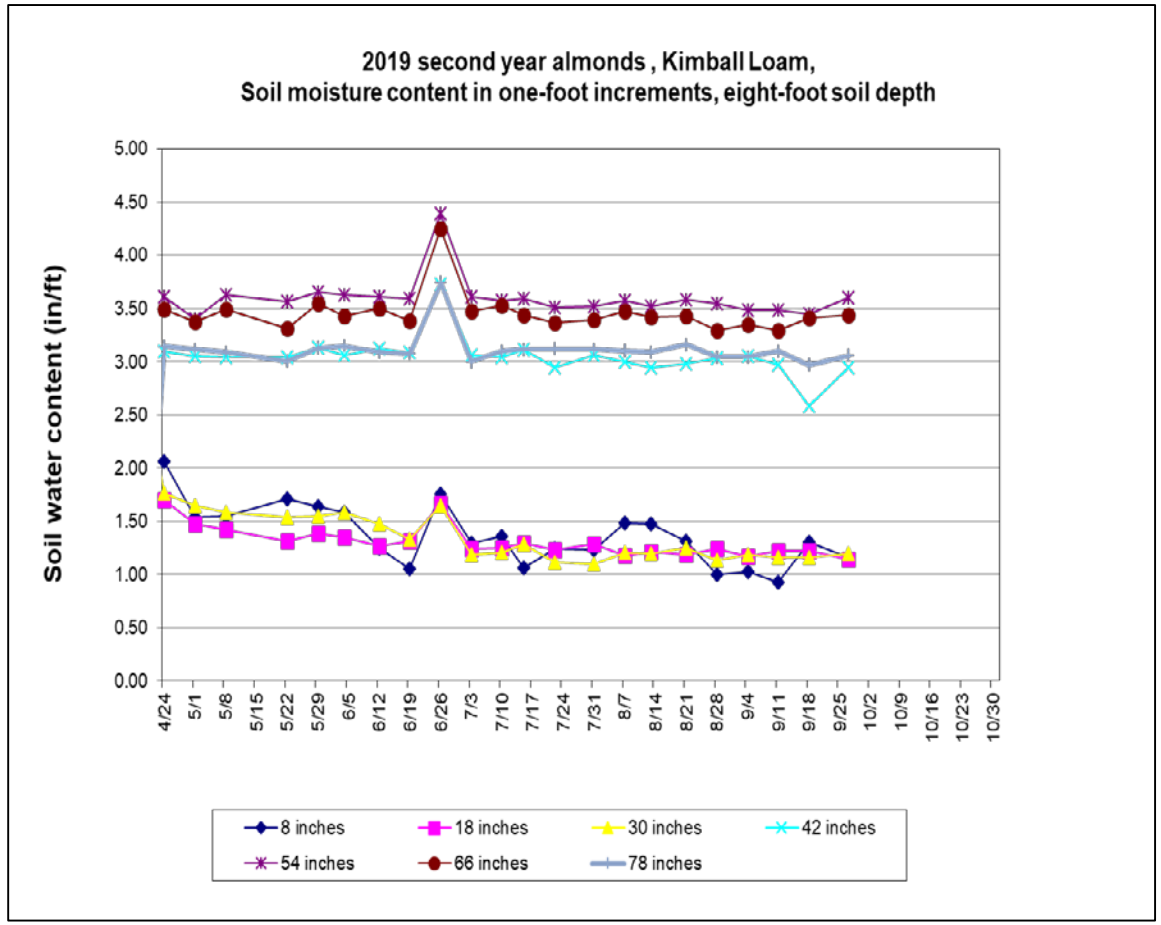
1. 3.2 inches available H_2O at 50 percent management threshold
2. 4.35 inches accum'd seasonal water use
3. 0.52 inches accum'd rainfall x 50 % (effective) = 0.26 inches
4. The Math:
   - 3.2" stored – 4.35" ETc + 0.26" Rain =
   - 3.2" – 4.4" + 0.3" = -0.9" past 50 percent depletion
5. MIGHT I WAIT ANOTHER WEEK TO BEGIN IRRIGATING? IF NOT, HOW MUCH WATER MIGHT I APPLY?

Pairing a water budget with soil moisture monitoring

2019 - 2nd Leaf Almond Orchard

Comparison of ET_c-based water budget and seasonal trends in volumetric soil water content. Good agreement between the two indicators.





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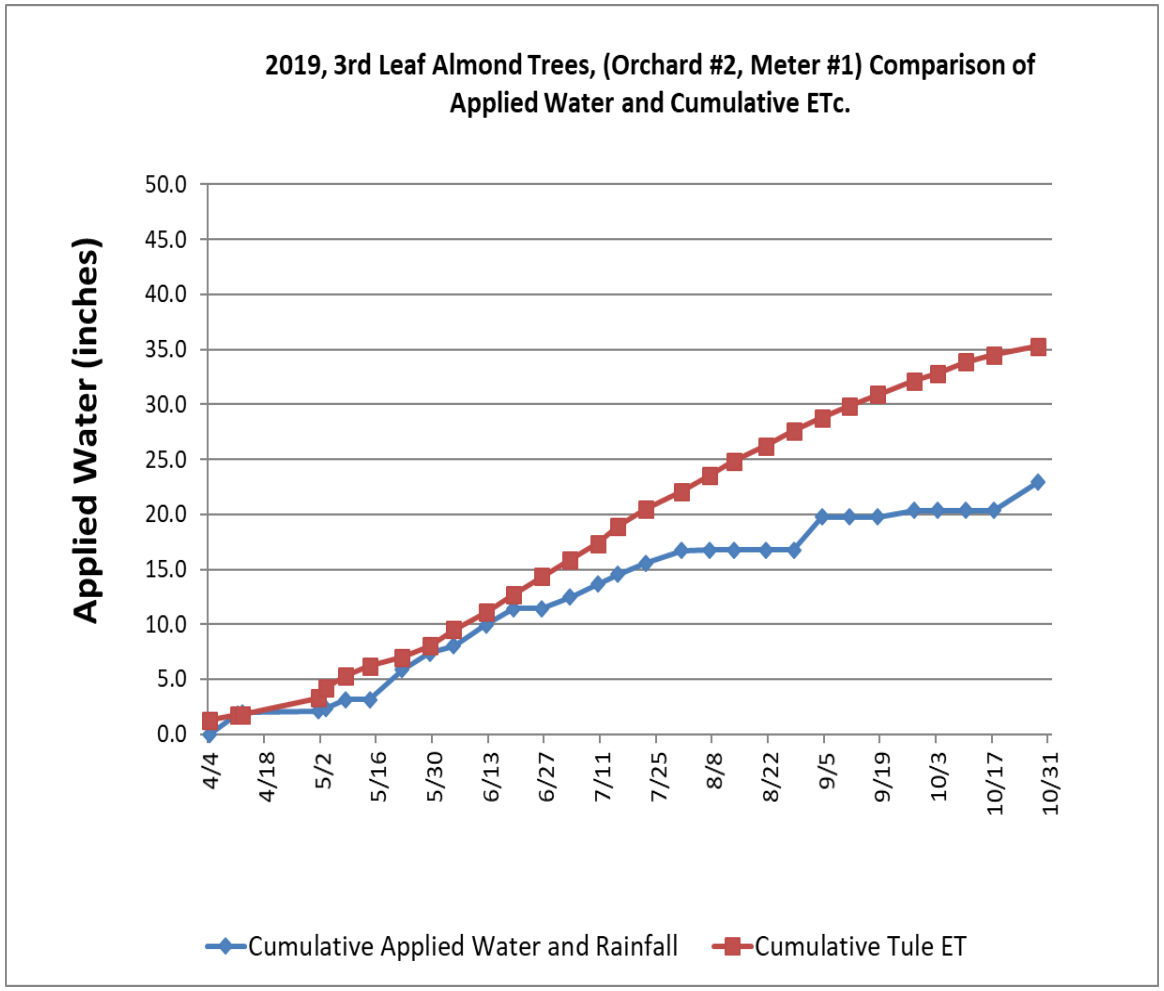
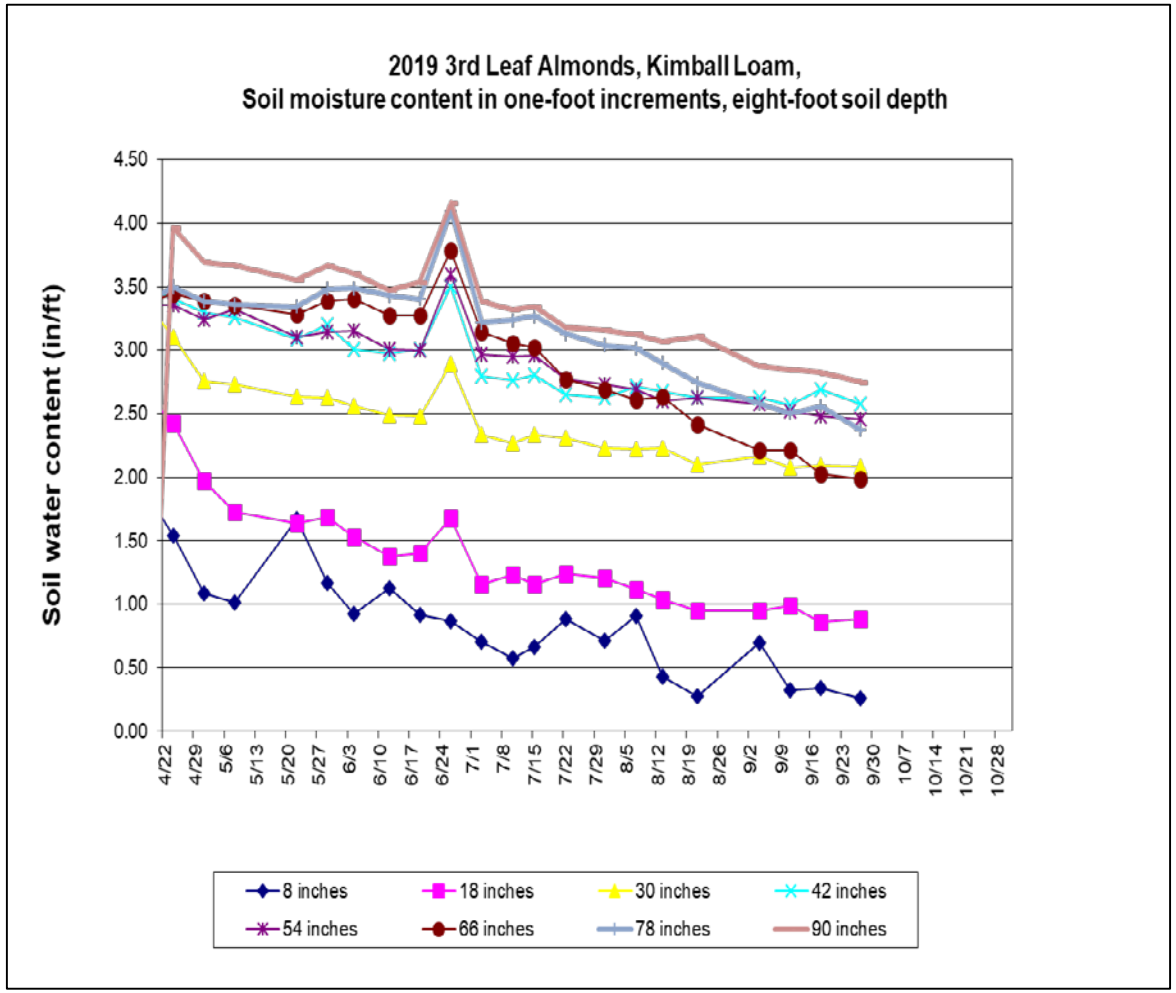
Comparison of ET_c-based water budget and seasonal trends in volumetric soil water content. Good agreement between the two indicators.





Last Knowledge Check #4

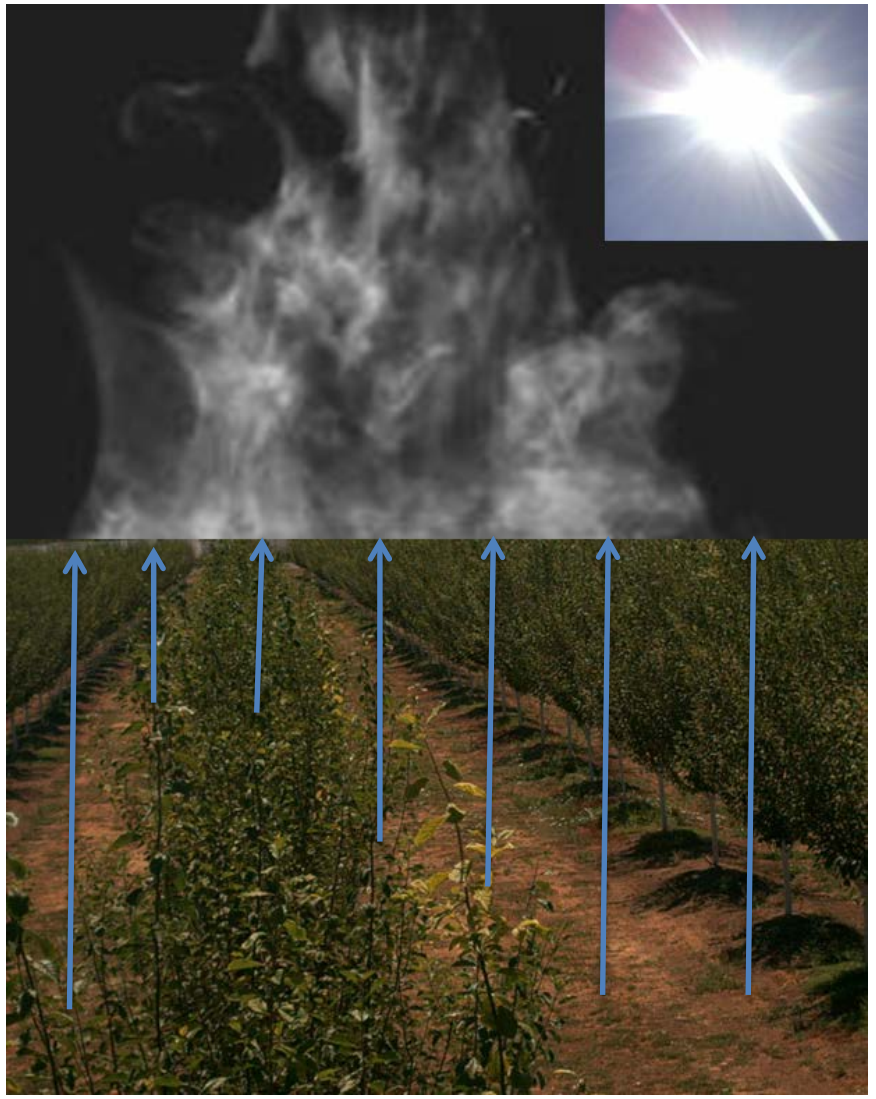
Why might an irrigation manager pair ET water budget information with actual soil moisture monitoring to help guide irrigation decisions?

How to adjust for different irrigation wetting patterns

The common question: Since I don’t irrigate the entire orchard floor, do I need to apply more water to compensate?

Remember Basic Crop ET Concept

The rate of ET_c is not greatly affected by the wetted area because the applied water is primarily taken up by the crop and transpired out the canopy surface which usually covers more area than a partial wetting pattern.



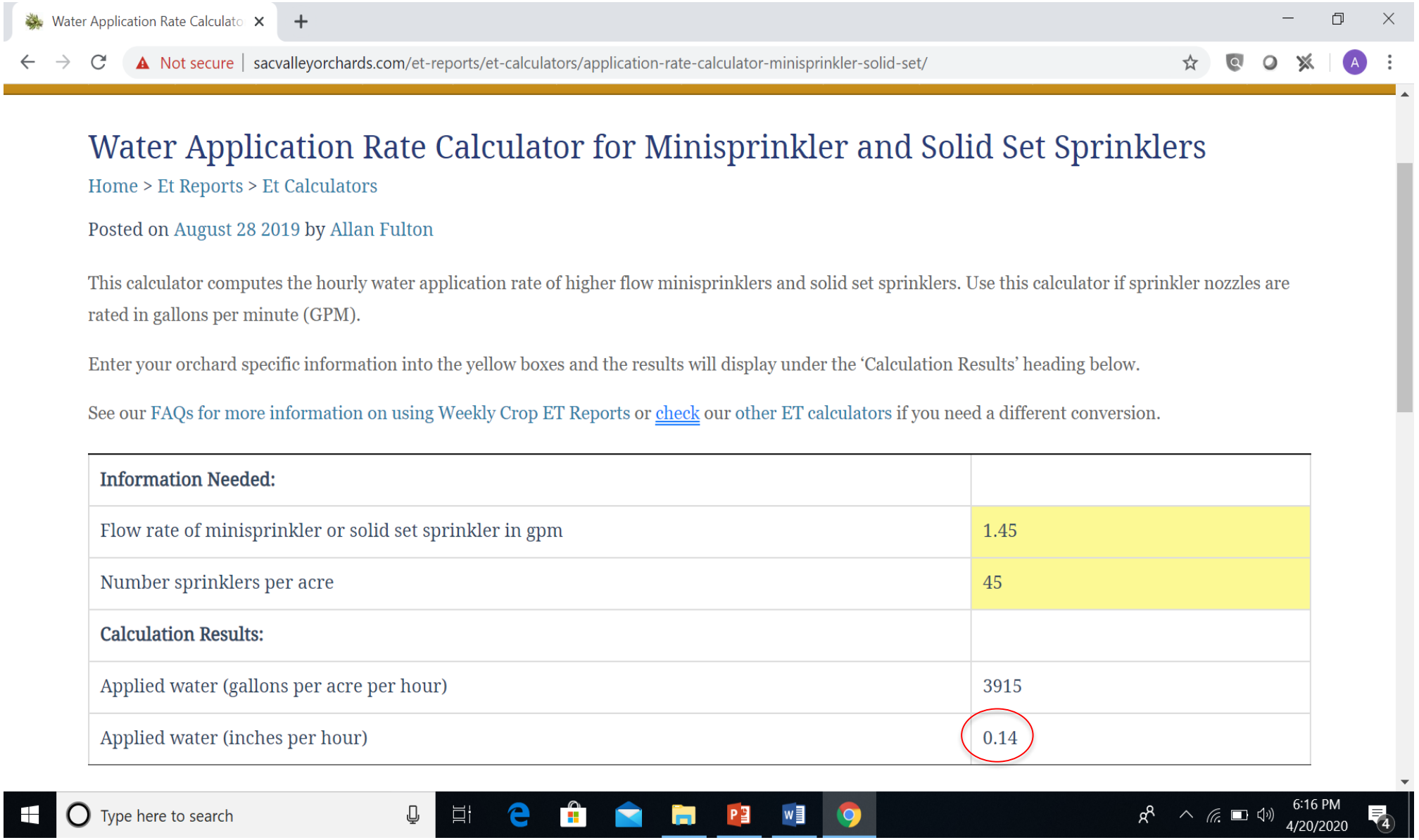
If anything, reducing the wetted area will reduce the rate of ET_c by reducing soil evaporation and slightly lessen (not increase) the amount of applied water needed.

The common question: Since I don’t irrigate the entire orchard floor, do I need to apply more water to compensate?

No, it is not necessary to apply more water to compensate for a smaller wetted pattern but it is necessary to irrigate differently.

- Smaller wetted areas translate to lower water application rates
- This translates to more hours of irrigation to apply equal amounts of water and match the same weekly ET
- Consequently, it may be necessary to irrigate more often each week
  - Soil intake rates (runoff) and soil water holding capacity (deep percolation) may govern this.
  - Utility TOU rates may also be a factor

Example Water Application Rate for a Solid Set Sprinkler Irrigation System in Walnuts



Water Application Rate Calculator for Minisprinkler and Solid Set Sprinklers

Home > Et Reports > Et Calculators

Posted on August 28 2019 by Allan Fulton

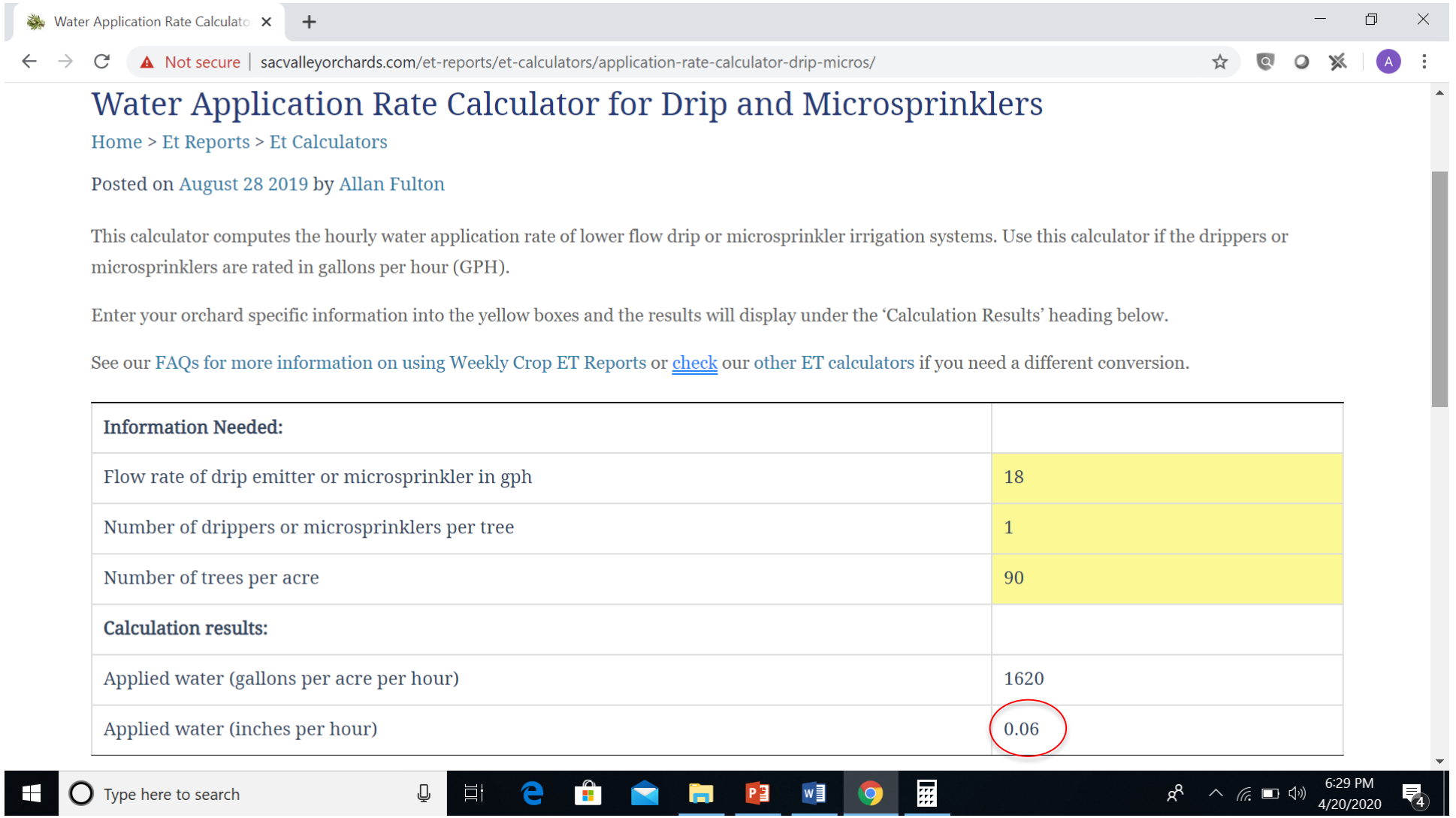
This calculator computes the hourly water application rate of higher flow minisprinklers and solid set sprinklers. Use this calculator if sprinkler nozzles are rated in gallons per minute (GPM).

Enter your orchard specific information into the yellow boxes and the results will display under the 'Calculation Results' heading below.

See our FAQs for more information on using Weekly Crop ET Reports or check our other ET calculators if you need a different conversion.

Information Needed:	
Flow rate of minisprinkler or solid set sprinkler in gpm	1.45
Number sprinklers per acre	45
Calculation Results:	
Applied water (gallons per acre per hour)	3915
Applied water (inches per hour)	0.14

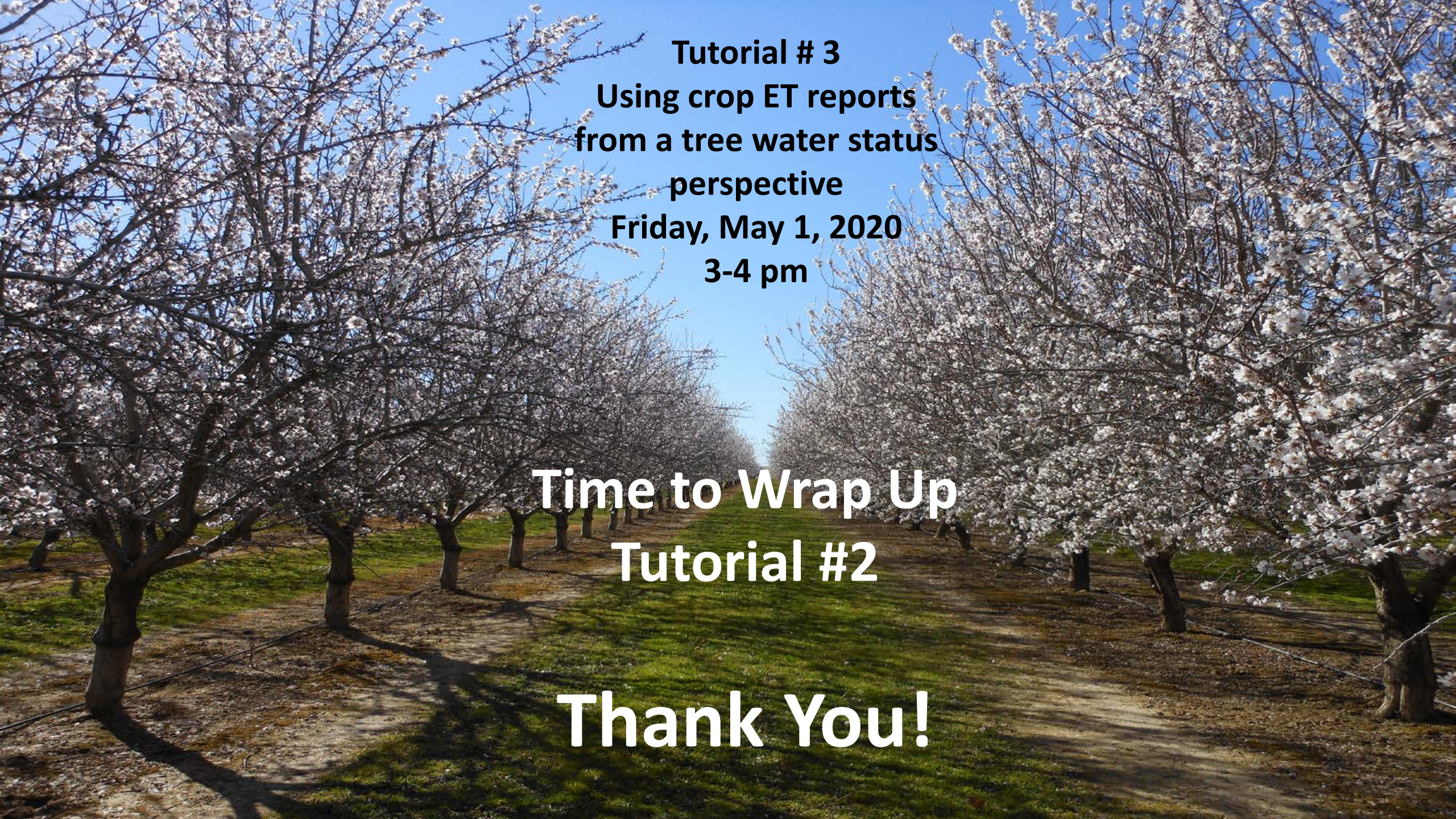
Example Water Application Rate for a Micro Sprinkler Irrigation System in Walnuts



Hours of irrigation to match 2 inches of ET_c

The math:

- Solid set sprinkler = 2.0 ET_c ÷ 0.14 inch/hr = 14.2 hours per week
  - Easily accomplished with one irrigation per week if intake rates allow
- Microsprinkler = 2.0 ET_c ÷ 0.06 inch/hr = 33.3 hours per week
  - May need to split into two irrigations per week to manage infiltration limitations and utility TOU rates


Tutorial # 3
Using crop ET reports
from a tree water status
perspective
Friday, May 1, 2020
3-4 pm
Time to Wrap Up
Tutorial #2
Thank You!