

# Tree Irrigation requirements

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# Learning objectives

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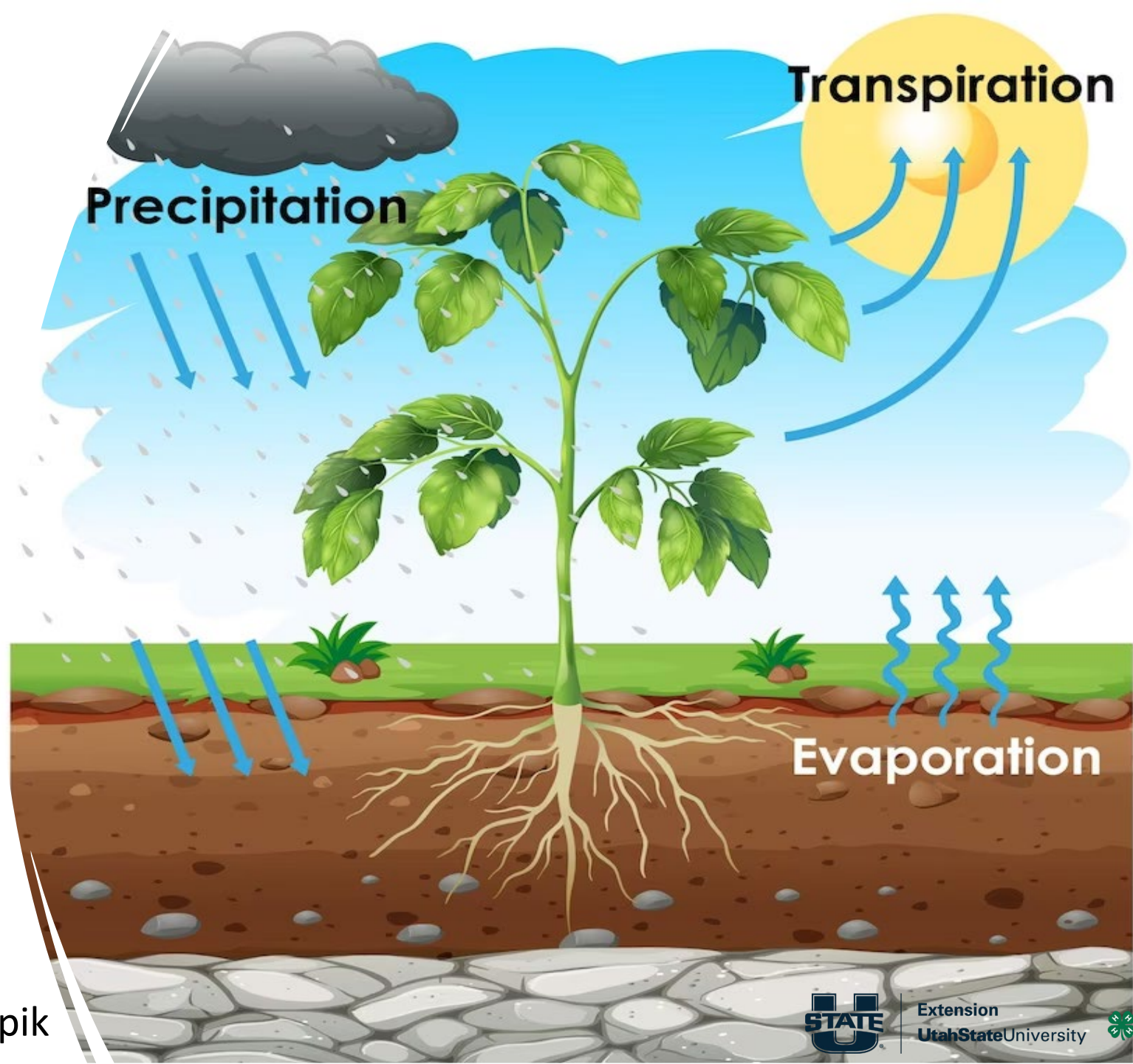
1. What is evapotranspiration water loss
2. What is plant factor
3. Why is water requirement for new and old tree different
4. Learn to use online calculator to calculate tree water requirement



# Evapotranspiration

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“Rate of evapotranspiration from an extensive surface of green grass of uniform height, actively growing, well-watered, and completely shading the ground (FAO, 1998)”

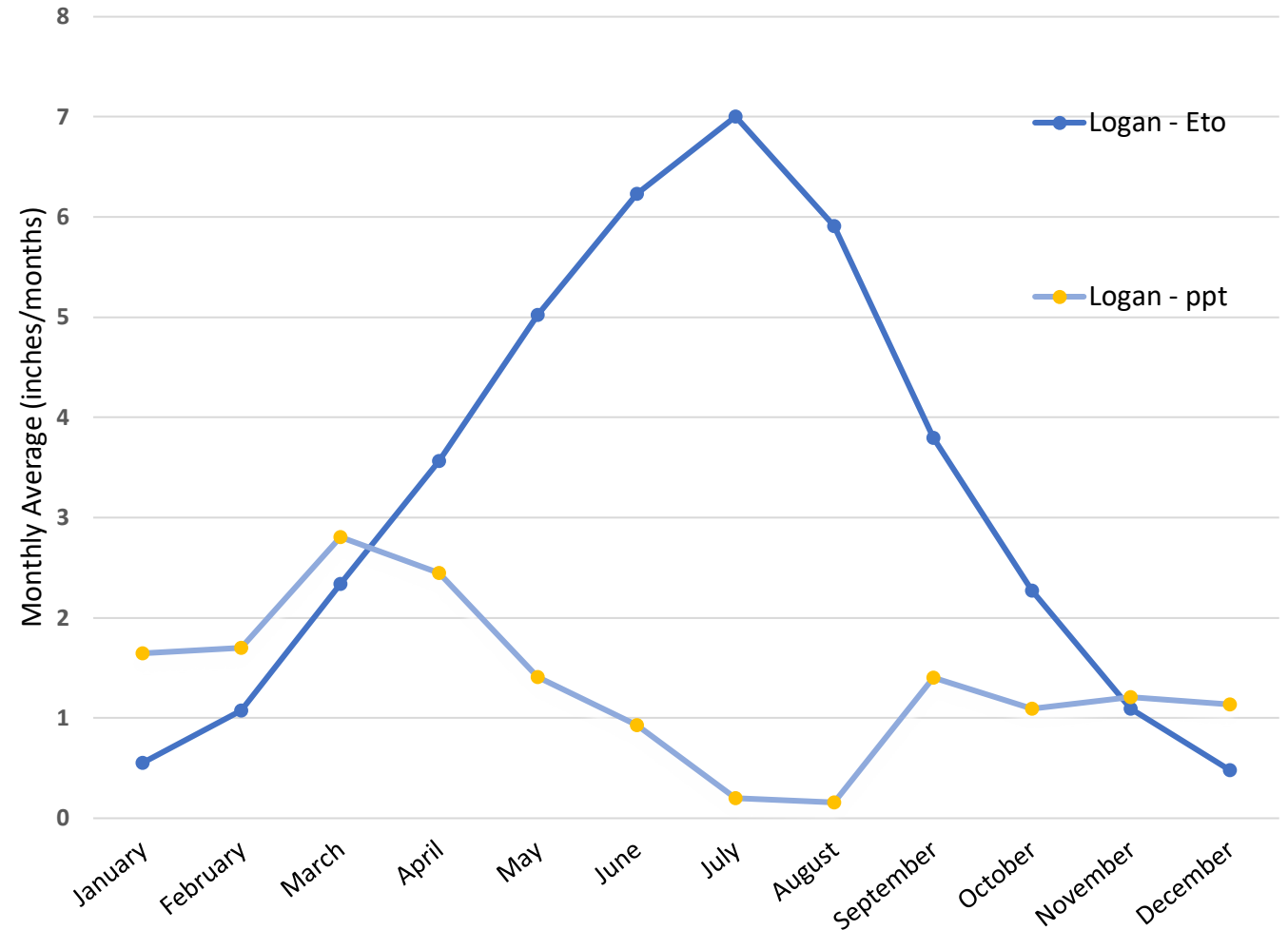


- Image by brgfx on Freepik

# Logan: ETo and Precipitation

When to start watering ?

Average ETo and Precipitation in Logan and Cedar City (2016-2020)



# Plant Factor

- Different plant species has different water requirement and different ability to cope with drought – Generally, slow growing plants are more adapted to drought compared to fast growing plants and fruit trees
- It is expressed as percentage of ETo
- It different by plant species



[https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2987&context=extension\\_curall](https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2987&context=extension_curall)

# Plant factor for common trees

## Plant factors used for various trees types:

- Mature broadleaf shade trees - 0.8
- Established native or low water use trees - 0.4
- Newly planted tree - 0.9
- Other trees - 0.5

<https://extension.usu.edu/forestry/files/publications/other-publications/selecting-and-planting-landscape-trees.pdf>



# Low water requirement – PF 0.3 to 0.4

- Ash, Green (*Fraxinus pennsylvanica*)
- \*Boxelder (*Acer negundo*)
- Catalpa, Northern or Western (*Catalpa speciosa*)
- \*+Chinaberry (*Melia azedarach*)
- Coffeetree, Kentucky (*Gymnocladus dioicus*)
- Corktree, Amur (*Phellodendron amurense*)
- Elm, American (*Ulmus americana*)
- Elm, Lacebark or Chinese (*Ulmus parvifolia*)
- \*Elm, Siberian or Chinese (*Ulmus pumila*)
- Ginkgo (*Ginkgo biloba*)
- Goldenraintree (*Koelreuteria paniculata*)
- Hackberry, Common (*Celtis occidentalis*)
- Hawthorns (Most) (*Crataegus species*)
- Honeylocust (*Gleditsia triacanthos*)
- Juniper, Chinese (*Juniperus chinensis*)
- Juniper, Rocky Mountain (*Juniperus scopulorum*)
- Juniper, Utah (*Juniperus utahensis*)
- Locust, Black (*Robinia pseudoacacia*)
- Maple, Amur or Ginnala (*Acer ginnala*)
- Maple, Sycamore (*Acer pseudoplatanus*)
- Maple, Tatarian (*Acer tataricum*)
- Maple, Trident (*Acer buergeranum*)
- Mulberries (*Morus species*)
- Oak, Bur (*Quercus macrocarpa*)
- Oak, Chinkapin (*Quercus muehlenbergii*)
- Oak, Gambel or Scrub (*Quercus gambelii*)
- Oak, Swamp White (*Quercus bicolor*)
- Osage-orange (*Maclura pomifera*)
- Pear, Callery (*Pyrus calleryana*)
- Pear, Common (*Pyrus communis*)
- Pine, Aleppo (*Pinus halepensis*)
- Pine, Austrian (*Pinus nigra*)
- Pine, Bristlecone (*Pinus aristata*)
- Pine, Japanese Black (*Pinus thunbergiana*)
- Pine, Limber (*Pinus flexilis*)
- Pine, Mugo (*Pinus mugo*)
- Pine, Ponderosa (*Pinus ponderosa*)
- Pine, Scotch or Scots (*Pinus sylvestris*)
- Pinyons (*Pinus monophylla* or *Pinus edulis*)
- Planetree, London (*Platanus X acerifolia*)
- Redbud, Eastern (*Cercis canadensis*)
- Redcedar, Eastern (*Juniperus virginiana*)
- \*Russian-olive (*Elaeagnus angustifolia*)
- Smoketree, Common (*Cotinus coggyria*)
- \*Tree-of-heaven or Ailanthus (*Ailanthus altissima*)
- Zelkova, Japanese (*Zelkova serrata*)

<https://extension.usu.edu/cwel/research/efficient-irrigation-of-trees-and-shrubs>



# Medium water requirement – PF 0.5 to 0.6

- Alders (*Alnus* species)
- Apple (*Malus pumila*)
- Apricot (*Prunus armeniaca*)
- Arborvitaes or White-cedars (*Thuja* species)
- Ash, White (*Fraxinus americana*)
- \*Aspen, Quaking (*Populus tremuloides*)
- Baldcypress (*Taxodium distichum*)
- Catalpa, Umbrella (*Catalpa bignonioides* 'Nana')
- Cedar of Lebanon (*Cedrus libani*)
- Cedar, Atlas (*Cedrus atlantica*)
- +Cedar, Deodar (*Cedrus deodar*)
- Cherry, European Bird, or May Day Tree (*Prunus padus*)
- Cherries, Ornamental (*Prunus yedoensis* and others)
- Cherry, Sour (*Prunus cerasus*)
- Cherry, Sweet (*Prunus avium*)
- Chokecherry, Common (*Prunus virginiana*)
- \*Cottonwoods or Poplars (*Populus* species; some)
- Crabapples (*Malus* species)
- +Crapemyrtle (*Lagerstroemia indica*)
- Dogwood, Corneliancherry (*Cornus mas*)
- Falsecypress, Hinoki or Hinoki Cypress (*Chamaecyparis obtusa*)
- Filbert, Turkish (*Corylus colurna*)
- Fir, White (*Abies concolor*)
- Goldenchain Tree (*Laburnum X watereri*)
- Hawthorn, English (*Crataegus laevigata*)
- Hazelnuts (*Corylus* species)
- Holly, American (*Ilex opaca*)
- Hornbeam, European (*Carpinus betulus*)
- Horsechestnuts or Buckeyes (*Aesculus* species)
- Incense-cedar (*Calocedrus decurrens*)
- Lilac, Japanese Tree (*Syringa reticulata*)
- Lindens or Basswoods (*Tilia* species)
- +Magnolia, Southern (*Magnolia grandiflora*)
- Maple, Canyon or Bigtooth (*Acer grandidentatum*)
- Maple, Hedge (*Acer campestre*)
- Maple, Norway (*Acer platanoides*)
- Maple, Purpleblow or Shantung (*Acer truncatum*)
- Maple, Rocky Mountain (*Acer glabrum*)
- Maple, Sugar (*Acer saccharum*)
- Oak, English (*Quercus robur*)
- Oak, Northern Red (*Quercus rubra*)
- Oak, White (*Quercus alba*)
- Pagodatree, Japanese or Scholar-tree (*Sophora japonica*)
- Peach (*Prunus persica*)
- Pine, Himalayan or Bhutan (*Pinus wallichiana*)
- Pine, Japanese Red (*Pinus densiflora*)
- Pine, Japanese White (*Pinus parviflora*)
- Pine, Lacebark (*Pinus bungeana*)
- Plums (*Prunus domestica* and others)
- Redwood, Dawn (*Metasequoia glyptostroboides*)
- Serviceberry, Downy (*Amelanchier arborea*)
- Spruce, Blue or Colorado Blue (*Picea pungens*)
- Spruce, Norway (*Picea abies*)
- Spruce, Serbian (*Picea omorika*)
- Spruce, White or Blackhills (*Picea glauca*)
- Sweetgum or American Sweetgum (*Liquidambar styraciflua*)
- Walnuts (*Juglans* species)
- Yellow-poplar or Tuliptree or Tulip-poplar (*Liriodendron tulipifera*)
- Yellowwood (*Cladrastis lutea* or *kentuckea*)

<https://extension.usu.edu/cwel/research/efficient-irrigation-of-trees-and-shrubs>



# High water requirement – PF 0.7 to 0.9

- Beech, European (*Fagus sylvatica*)
- \*Birch, European White (*Betula pendula*)
- Birch, Water or River (*Betula occidentalis*)
- Dogwood, Kousa (*Cornus kousa*)
- Dogwood, Pagoda (*Cornus alternifolia*)
- Douglas-fir (*Pseudotsuga menziesii*)
- Katsuratree (*Cercidiphyllum japonicum*)
- Larches (*Larix* species)
- Magnolias (*Magnolia* species; most)
- Maple, Japanese (*Acer palmatum*)
- Maple, Paperbark (*Acer griseum*)
- Maple, Red (*Acer rubrum*)
- Mountain-ashes (*Sorbus* species; most)
- Sequoia, Giant (*Sequoiadendron giganteum*)
- \*Willows (*Salix* species)

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# Why are trees unique

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## Deep root

Apply longer irrigation up to 18 inches of soil.

## Drought symptoms are observed late

Best to check soil moisture to at least 12 inches deep

## Recovery very difficult

Water at least weekly to biweekly in summer seasons

# New tree vs old tree consideration

- New trees
  - Limited root system
  - Root still growing.
  - Loss of roots (up to 75%) during shipping or uprooting
  - Hyperactive root growth to penetrate soil
- Smaller tree need less time to establish while large tree need longer time
- Measure Trunk diameter at 6 inch for <4 inch tree diameter and at 12 inches above ground for > 4 inches tree diameter.
- Trunk diameter and establishment time
  - 1 inch – 1 growing season
  - 2 inch – 2 growing season
  - And so on...



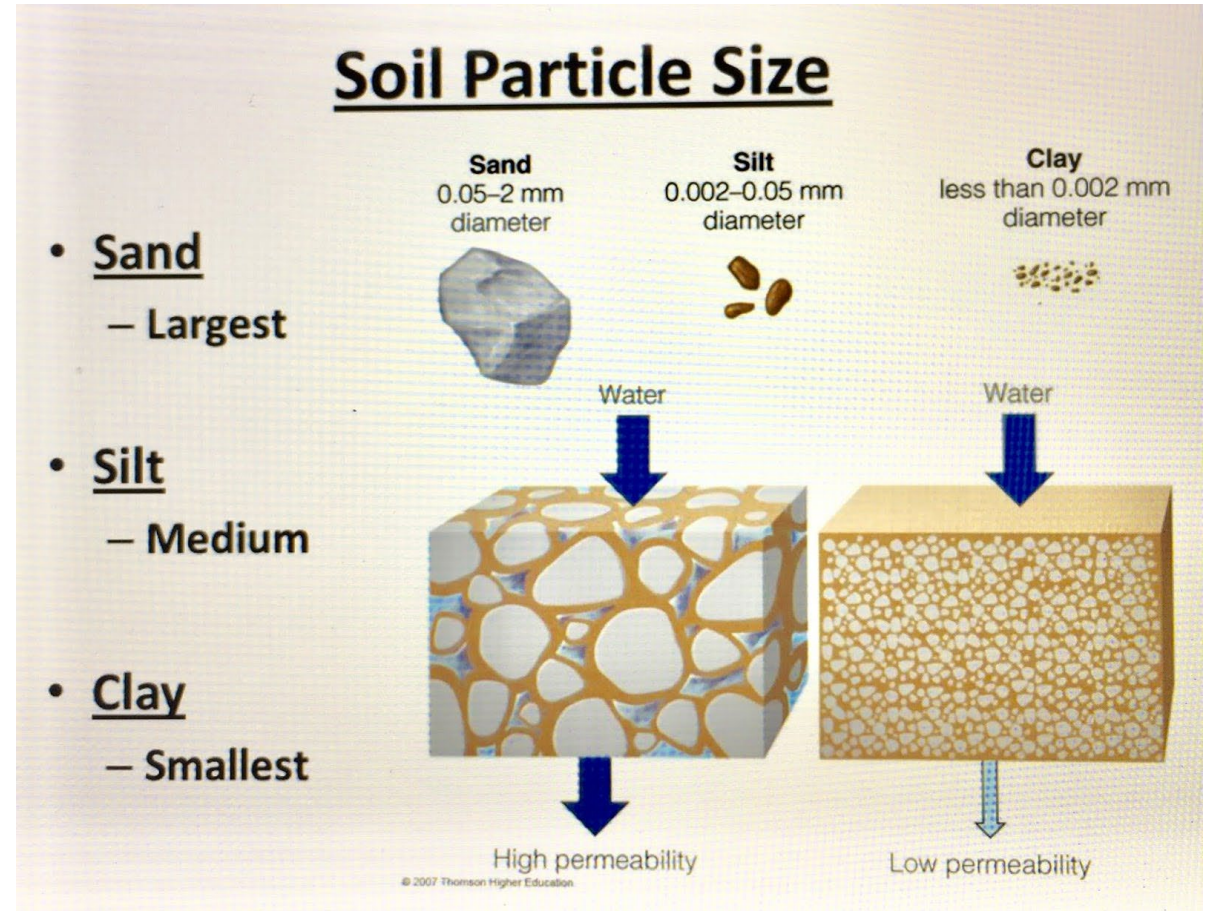
# New tree vs old tree consideration

- Immediately water newly planted trees to soak the root ball area.
- For, new trees, water 3 times a week for 1<sup>st</sup> month, 2 times a week for 2<sup>nd</sup> month and 1 – 2 times a week for third month and fourth month.
- Once the trees are established watering one a week in summer in clay to clay-loam soil is appropriate.



# Irrigation based on type of soil

Soil Type	Infiltration Rate (inches per hour)
Sandy	0.5 - 3
Loamy	0.2 - 1
Clay	< 0.4



<http://www.universityplacecommunitygarden.org/2019/03/rock-paper-scissors-sand-silt-clay.html>

## General consideration for watering trees

#Water weekly or biweekly - 10 gallon of water every week for each inch of trunk diameter

#If trunk diameter is less than 1 inch water 5 gallon of water every week.

# Bag or bucket technique



Amleonard website



<https://www.mapleleavesforever.ca/watering-young-maple-trees/>



Being more precise





# Tree growing on healthy turf area

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- Water required (gallons)=  
Evapotranspiration x plant  
factor x Landscape area x 0.623

Water is usually enough when you maintain healthy turf but consider longer water duration at least once in 15 days.



# Isolated trees or trees grown on unirrigated turf area

- Water required (gallons)=  
Evapotranspiration x plant  
factor x tree canopy  
diameter x 0.623

$$\text{Tree canopy diameter} = (\text{diameter 1} + \text{diameter perpendicular to diameter 1})/2$$

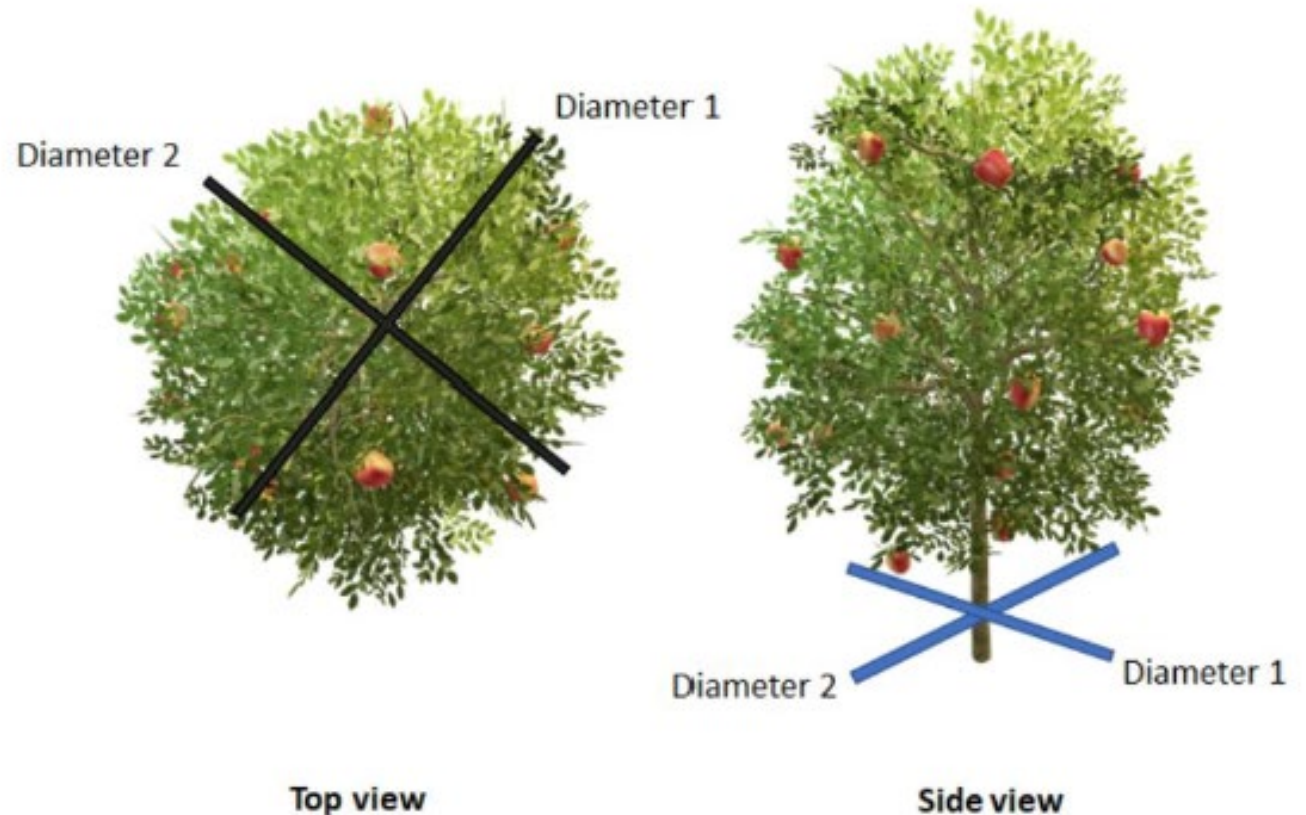
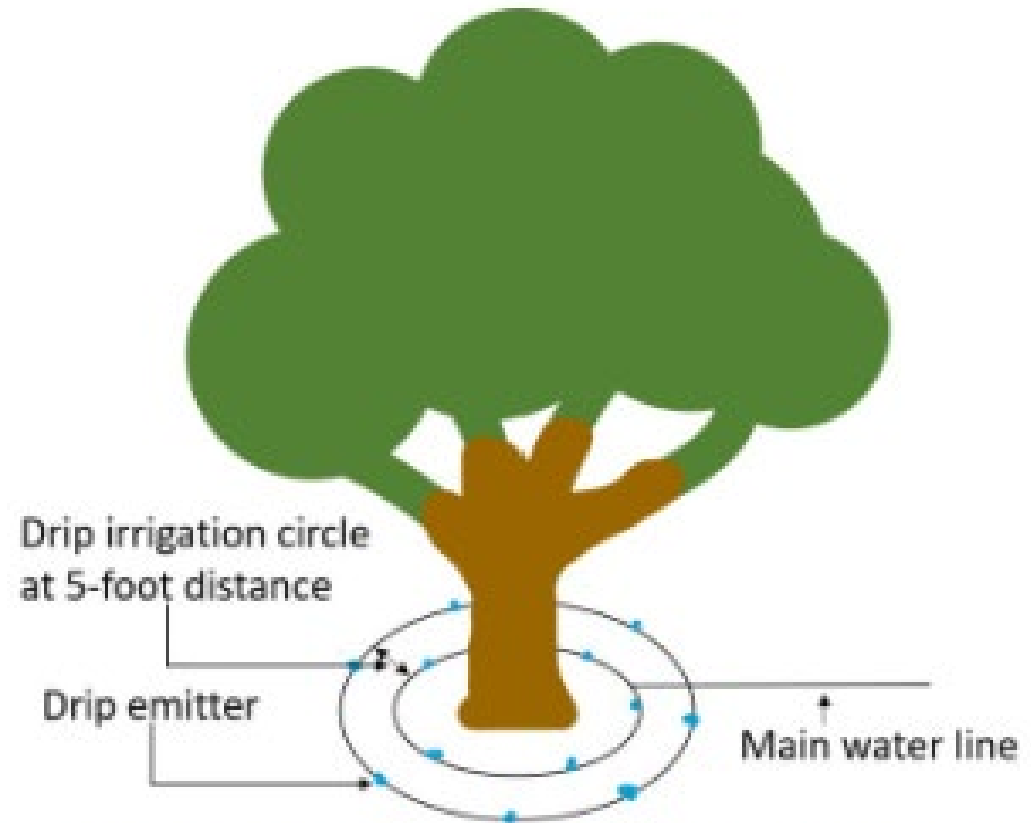


Figure 1. Calculating a Tree Canopy (feet)

# Using USU tree irrigation calculator

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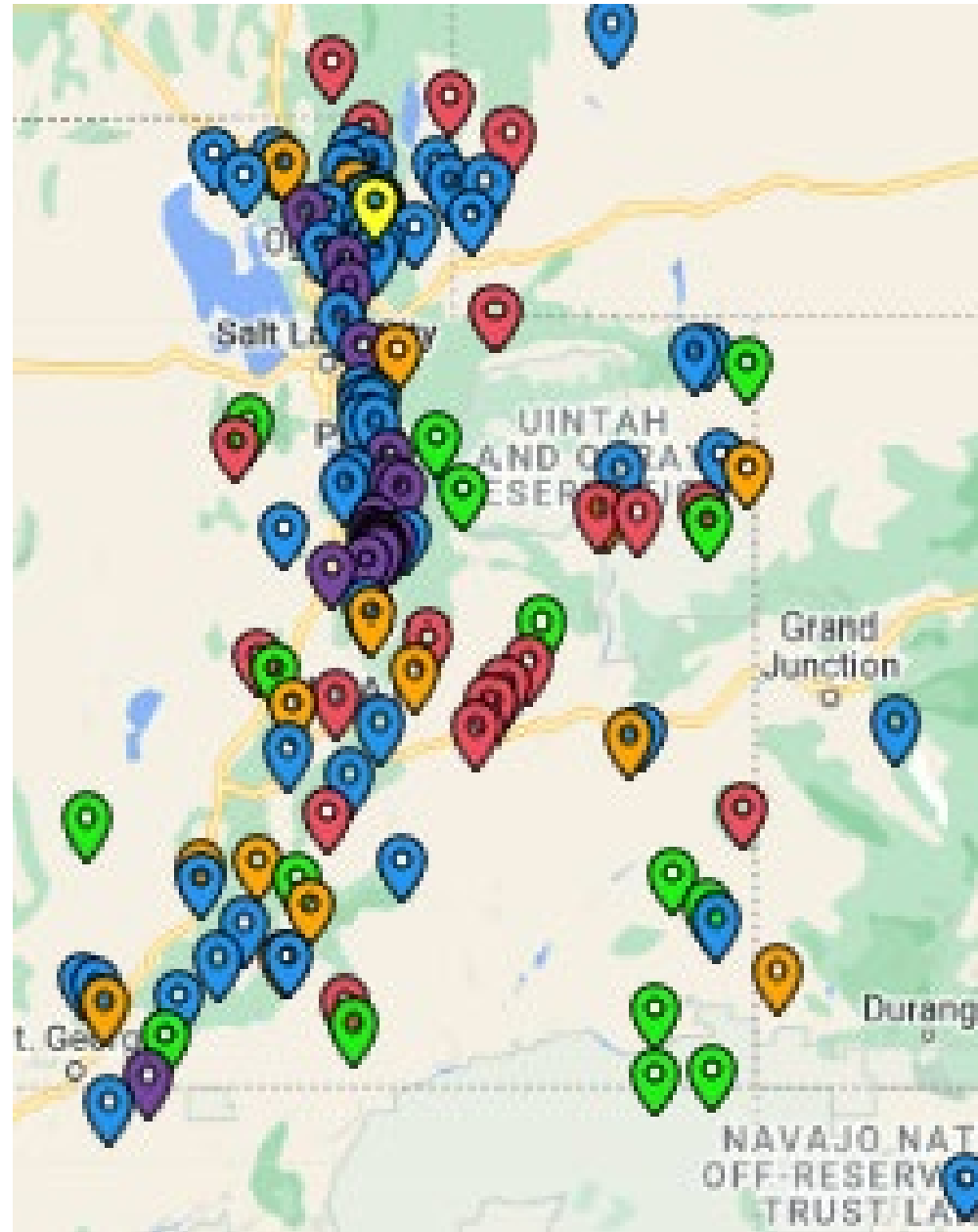


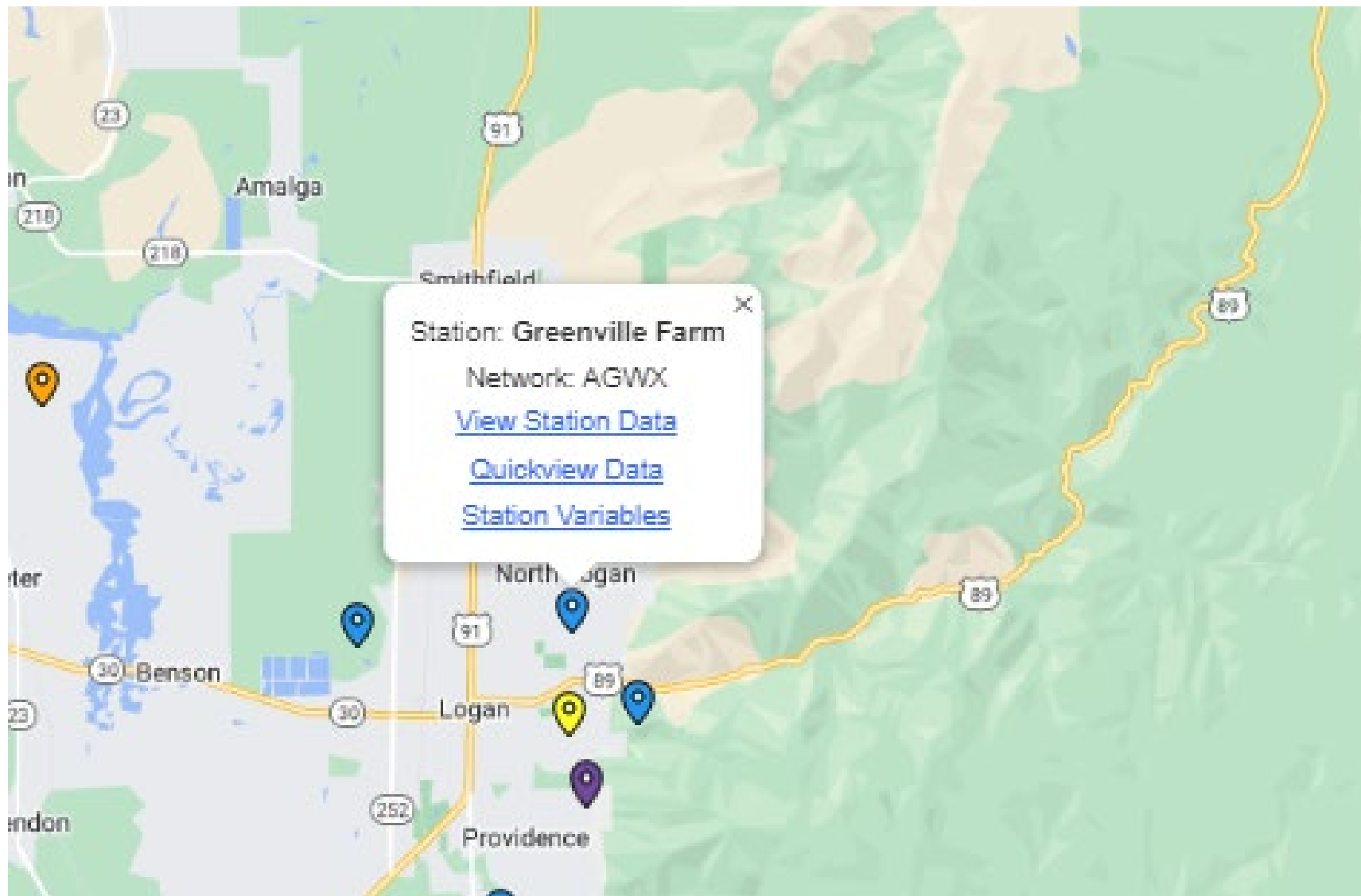
**Figure 4.** *Irrigation Loop Placement Strategy Under a Tree*

### Information on existing conditions

Diameter of tree canopy	20	feet
Weekly reference evapotranspiration (ET <sub>o</sub> ) in inches	1.5	inches
Weekly precipitation (P) in inches	0.2	inches
Amount of water loss in gallons	253.08	gallons
Type of tree (click to select from drop down)	Mature broadleaf shade trees	
Soil type (click to select from drop down)	Sandy loam	
Recommended irrigation based on tree and soil type	101 gallons/biweekly	







## Daily

timestamp	AirT_Avg (°F)	AirT_Max (°F)	AirT_Min (°F)	RH_Max (%)	RH_Min (%)	Td_Avg (°F)	Td_Max (°F)	Td_Min (°F)	SolarMJ (MJ/m <sup>2</sup> )	WindS_Avg (mph)	WindD_Avg (°)	WindS_Max (mph)	Precip (In)	Soilt4_Avg (°F)	Soilt8_Avg (°F)	SoiltVWC8_Avg (%)	ETo (In)	ETr (In)
2023-03-13	32.9	42.9	23.2	95.1	68.6	29.3	34.4	21.9	14	1.9	197	10.2	0.030	32.1	33.6	31	0.06	0.06
2023-03-12	28.0	33.2	23.6	94.2	72.9	23.9	27.5	18.4	13	1.6	225	8.0	0.030	32.1	33.7	32	0.04	0.05
2023-03-11	29.4	37.1	21.2	95.0	42.6	20.0	25.8	15.5	20	1.9	168	8.3	0.050	32.1	33.6	33	0.08	0.09
2023-03-10	38.6	52.9	26.8	96.0	47.7	31.7	37.4	22.4	9	7.5	180	37.1	0.260	32.2	33.8	32	0.06	0.08
2023-03-09	23.0	29.5	15.0	96.0	61.4	19.6	23.4	13.6	19	2.3	222	9.6	0.200	32.2	33.8	29	0.06	0.06
2023-03-08	15.2	22.8	5.7	95.4	83.0	13.0	20.2	3.2	9	1.6	207	10.0	0.010	32.2	33.9	29	0.02	0.03
2023-03-07	15.6	22.3	7.0	91.5	62.5	11.3	14.8	4.5	19	1.8	189	8.0	0.000	32.3	33.9	29	0.04	0.05



## Recommendations for installing a new irrigation system

Recommended number of drip irrigation circles (loop)

Length of loop/pipe for each circle (circumference)

Number of emitters (space them every 5 feet)

Emitter flow rate - gallons per hour (gph)

Run time

1			
31.4	0	0	0
6	0	0	0
5			
3.37 hours on each irrigation event			



**Recommendations for an existing irrigation system**

Total number of emitters in the root zone

22

Emitter flow rate gph

5

Run time

0.92 hours on each irrigation event





# SMITHFIELD

*Utah*



Thank you!

Questions?

