UCCE
El Dorado County
Master Gardeners
Present

Water-resilient Landscapes
Part 2
Water-resilient Landscapes

**Agenda:**
- Overview
- California Water Story
- It Starts with the Soil
- Hydrozoning & Plant Selection
- Irrigation
- Capturing & Utilizing Rainwater
- Q & A Class Wrap-Up
Resources

- **CNPS – What Grows Here?** [https://www.calflora.org/entry/wgh.html](https://www.calflora.org/entry/wgh.html)
- **Calscape Advanced Search:** [https://calscape.org/login.php](https://calscape.org/login.php)
- **River Friendly Inspiration Gardens:** [http://www.ecolandscape.org/riverfriendly/topics/inspiration-garden.html](http://www.ecolandscape.org/riverfriendly/topics/inspiration-garden.html)
- **The Regional Water Authority's Water-Wise Gardening software:** [http://www.rwa.watersavingplants.com/](http://www.rwa.watersavingplants.com/)
- **The UC Davis Arboretum All-Stars:** [http://arboretum.ucdavis.edu/arboretum_all_stars.aspx](http://arboretum.ucdavis.edu/arboretum_all_stars.aspx)
- **Eco-Friendly Landscape Design Plans for the New California Landscape:** [www.ecolandscape.org/new-ca/](http://www.ecolandscape.org/new-ca/)
- **The Bay Area Bringing Back the Natives** website includes useful information on using California natives in the landscape.
- **California plant database search tool** — [www.waterwonk.us](http://www.waterwonk.us)
Water Conservation

1. Remove & replace lawn
   • Lawn substitutes

2. Establish Hydrozones

3. Utilize drought-tolerant plants

4. Install dripline irrigation system
Hydrozoning

The practice of clustering together plants with similar water requirements in an effort to conserve water

- Sun, partial shade, shade
- Water needs (high, medium, low)
- Plants in the ground
- Plants in pots
- Veggie beds

It is a proven effective water management solution
This planting design was based on irrigation. Plants were grouped together according to water use, making it easy to create the hydrozones and valve zones.
Landscape Design based on Water-use
Logical Separations of Hydrozones
Troubleshoot
Water-use
Differences
Hydrozoning an Existing Landscape

• Draw a plan of your property indicating your trees, shrubs, annuals, lawn, a vegetable garden and other plants

• Circle and group plants with similar water needs in hydrozones

• Separate hydrozones would include:
  • Lawn
  • Mass plantings of perennials and groundcovers
  • Vegetable garden and or mass plantings of annuals/bedding plants
  • Sun vs. Shade
  • Flat vs. Slopes

• Not sure of your plants' watering needs? Find out the water requirements of specific plants, by clicking on the link: http://ucanr.edu/sites/WUCOLS/
• **The Water Use Classification of Landscape Species**
  • An online system maintained by the UC Division of Agriculture and Natural Resources
  • Developed by and based on the field experience of landscape horticulturalists & professionals
  • User-friendly enough for home gardeners
WUCOLS IV

• Provides information on water needs of more than 3500 plants
• Different plant species require different amounts of water for optimal health
• Plant Factor (PF) - Expressed as a percentage of ETo

Water Budget = Weather x Plant Factor x Area
WUCOLS IV

Water Use Classification of Landscape Species

Plant Search Database

If you know exactly which plant you are interested in, you may search for it by name (partial names are OK, too). Otherwise, consider searching by plant type and/or water use.

City
Search for a city: Citrus Heights

Find a city on the map

Plant Name
Nandina

Water Use
- Very Low
- Low
- Moderate/Medium
- High
- Unknown
- Not Appropriate for this Region

Plant Type
- Gc (Ground Cover)
- P (Perennial)
- S (Shrub)
- T (Tree)
- V (Vine)
- Ba (Bamboo)
- Bu (Bulb)
- G (Ornamental Grass)
- Pm (Palm and Cycad)
- Su (Succulent)
- N (California Native)
- A (Arboretum All-star)

Search Plants
## Plant Search Database

<table>
<thead>
<tr>
<th>City</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citrus Heights</td>
<td>Central Valley</td>
</tr>
</tbody>
</table>

### Legend: Plant Types

- Nandina domestica

### Legend: Categories of Water Needs

- Low
- Moderate/Medium

### Search Results: 2

<table>
<thead>
<tr>
<th>Type</th>
<th>Photo</th>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Water Use</th>
<th>Export</th>
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<tbody>
<tr>
<td>S</td>
<td>N/A</td>
<td><em>Nandina domestica</em></td>
<td>heavenly bamboo</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>N/A</td>
<td><em>Nandina domestica 'Purpurea'</em></td>
<td>heavenly bamboo (Nana)</td>
<td>Moderate/Medium</td>
<td></td>
</tr>
</tbody>
</table>
Evapotranspiration (ETo)

- The loss of water to the atmosphere by the combined process of:
  - Evaporation from the top 1" of the soil and plant surfaces
  - Transporation through plant tissues
Factors Affecting ETo

- Solar Radiation
- Air Temperature
- Relative Humidity
- Wind Speed
- Soil Exposure
- Planting Density
"Lawns, by acreage, are the nation’s largest irrigated crop, surpassing corn."

Lawns are a vestige that started with English gardens and spread by those living in water-rich environments in the East and mid-West.

The future profits of the lawn care and horticulture industries rely on the endurance of the myth that we need lawns and persistent sprawl.

Lawn rebate program in L. A. will save approximately 47 million gallons of water each year.

9.2 billion gallons of water have been saved through turf removal in Las Vegas.

Time and money consuming.
Lawns

Ecological deserts
- Monocrop
- Ecological deserts for pollinators

Fertilizers and pesticides
- Contaminate groundwater
- Pollute waterways
- Toxic to children and pets
  - Fourteen of the 30 most commonly used lawn pesticides are neurotoxins are known or suspected carcinogens, and two-thirds of them may cause reproductive harm in humans

Fossil fuels
- Costly
- Air pollution

Contribute to carbon dioxide load
Troubleshoot Water-use Differences
## Troubleshooting Water-use Differences

<table>
<thead>
<tr>
<th>Determine</th>
<th>Determine WUCOLS classification</th>
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</thead>
<tbody>
<tr>
<td>Prioritize</td>
<td>Prioritize plants to save</td>
</tr>
<tr>
<td>Remove</td>
<td>Remove unhealthy, diseased plants</td>
</tr>
<tr>
<td>Remove</td>
<td>Remove lower priority plants from crowded areas</td>
</tr>
<tr>
<td>Move / regroup</td>
<td>Move and regroup plants according to water needs</td>
</tr>
<tr>
<td>Replant</td>
<td>Replant where it makes sense; use plants that match the water needs in the area</td>
</tr>
</tbody>
</table>
Irrigation

Watering to keep plants healthy
Know Your Soil Texture

- Soil probe
- Hand test
- Jar test
- SoilWeb app
- Percolation test
Determine Soil Texture

- Sand
- Silt
- Clay
Soil Texture
Sandy Soils

- Particles are loose and coarse
- Squeezed in hand when dry, it falls apart when pressure is released
- Squeezed when moist, it will form a cast, but crumble easily when touched
- Water more frequently and higher amounts
Silty Soils

- Has a moderate amount of fine grains
- When dry, it can be readily broken
- Squeezed when wet, it will form a cast that can be easily handled
Clay Soils

• When dry, forms hard lumps or clods
• When wet, soil is quite plastic and flexible
• When squeezed between the thumb and forefinger, soil will form a ribbon that will not crack
• Water less frequently, and lower amounts
Loam

- Equal parts sand, silt & clay
- Contain more nutrients, moisture, and humus than sandy soils
- Better drainage and infiltration of water and air than clay soils
- Easier to till than clay soils
How Does Water Act in Soil?

Figure 1. Comparative movement of water in sandy and clayey soils
<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Intake Rate</th>
<th>Sprinkler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>.10 in/hr</td>
<td>Rotary nozzle (cycle)</td>
</tr>
<tr>
<td>Clay Loam</td>
<td>.20 in/hr</td>
<td>Rotary nozzle (cycle)</td>
</tr>
<tr>
<td>Loam</td>
<td>.35 in/hr</td>
<td>Rotary nozzle (cycle)</td>
</tr>
<tr>
<td>Loamy Sand</td>
<td>.40 in/hr</td>
<td>Rotary nozzle (cycle)</td>
</tr>
<tr>
<td>Sand</td>
<td>.60 in/hr</td>
<td>Any sprinkler (cycle)</td>
</tr>
<tr>
<td>Soil Type</td>
<td>Intake Rate</td>
<td>Emitter Flow</td>
</tr>
<tr>
<td>--------------</td>
<td>------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Clay:</td>
<td>.10 inches/hour</td>
<td>.26, .4, .5 gph</td>
</tr>
<tr>
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<td>.26, .4, .5 gph</td>
</tr>
<tr>
<td>Loam:</td>
<td>.35 inches/hour</td>
<td>.4, .5, .6 gph</td>
</tr>
<tr>
<td>Sandy Loam:</td>
<td>.40 inches/hour</td>
<td>.5, .6 gph</td>
</tr>
<tr>
<td>Sand:</td>
<td>.60 inches/hour</td>
<td>.9, 1.0 gph</td>
</tr>
</tbody>
</table>

Match Emitter Flow to Soil Type
Irrigation System Components

Important to understand system components, their function and how they affect efficiency
Water Meter & POC

• Measures water being used
  • Leak detection
  • Flow rate of an irrigation zone
  • Standard water meter sizes are: 5/8” & 3/4”

• Point of Connection (POC)
  • Where the irrigation mainline connects to the water service line
Pressure Regulation
Remote Control Valves (RCVs): work with Controllers to irrigate various landscape zones

- A group of RCVs is called a manifold
- Locate adjacent to walkways or hardscape for easy access
- Always used normally-closed valves
- 24-volt or DC (for battery- or solar-powered solinoids)
Remote Control Valves

- In-ground RCVs may only be used when a backflow prevention device is used
- Above-ground RCVs must be installed with anti-siphon valves
  - Must be 12" higher than the highest point of the valve system
Controllers & Sensors

- Irrigation controllers control operation of electric remote-control valves
  - Conventional vs. Weather-based
  - EPA WaterSense-labeled irrigation controllers

- Sensors respond to specific site conditions and modify operation of the controller
  - Soil moisture
  - Rain
  - Flow
  - Wind
  - Evapotranspiration
Irrigation Application Devices

• **Overhead Irrigation**
  - Apply water on the surface through the air
  - Best for turf and low-growing groundcover

• **Types:**
  - Fixed-spray heads
  - Rotating sprinklers
  - Rotors
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<td>Sand</td>
<td>.60 in/hr</td>
<td>Any sprinkler (cycle)</td>
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</tbody>
</table>

Match Sprinkler to Soil Type
Fixed-spray Sprinklers

• Apply a fan of water over a given area
• Radius: 2-17 feet
• Application rate: 15. - 2.0 inches/hour or more
  • Exceeds the infiltration rate of most soils
• Typical operating pressure: 30 psi
• 6"-pop-ups recommended for turf
• Built-in check valves to prevent low-head drainage
• Pressure regulation to avoid misting
• Matched precipitation rate (MPR) nozzles
• Fixed and variable-arc nozzles
• High-efficiency nozzle can improve Distribution Uniformity
Rotating Sprinklers

• Apply rotating stream of water over a given area
  • Wind-resistant stream
• More uniform coverage than fixed-spray
• Application rate: 0.4 - 0.8 inches/hour
• Radius: 6-35'
• Operating pressure: 35-55 psi
• Nozzles compatible with same bodies for fixed spray
  • Easy to retrofit
Rotors

- Apply a single stream of water over a given area
- More uniform coverage than fixed-spray heads
- Application rate: 0.4 - 15 gallons per minute
- Matched-precipitation rate nozzles
- Radius: 15-52 feet
- Operating pressure: 20-100 psi
  - Can operate at higher pressures
- Impact-type have a lower uniformity of coverage
Inefficient Fixed Spray Sprinklers
Efficient Solution: Rotary Nozzles
Poor Sprinkler Coverage
Good Sprinkler Coverage
Drip Irrigation

• Applies water to a single spot or spots along a pipe
• Suitable for the irrigation of trees, shrubs, groundcover and perennials
• Less water loss to evaporation, runoff, overspray or wind drift
• Application rate: variable depending on design
• Do not mix with other drip devices with different application rates
• Filters and pressure regulation may be needed to meet specification for operation
Two Types of Drip

• Point Source
  • Emitters placed at the plants for sparse plantings

• Line Source
  • Built-in emitters in a grid for dense plantings
Line Source: Dripline

- Emitters are embedded inside tubing spaced evenly at various distances (6", 12", 18" or 24")
- Flow rates: 0.26-1.0 gallons per hour (GPH)
- Match emitter flow to soil type and infiltration rate
- Grid layout provides even application of water
- Typical tubing diameter: ¾", ½" and ¼" (short runs only)
  - Netafim: 17mm and 12mm
Dripline

• Never mix dripline of different flow rates or emitter spacing
• Base emitter flow and spacing on soil type and infiltration rate
• Best to select pressure compensating emitters
• Grid layout should have supply and exhaust headers
• Don’t exceed maximum line run length set by manufacturer
• Include flush valves at low points and air vacuum relief at high points
Water Drainage by Soil Type

- Sandy: Fast
- Loamy: Moderate
- Clay: Slow
## Dripline Selection

<table>
<thead>
<tr>
<th>TECHLINE CV</th>
<th>TURF</th>
<th>SHRUB &amp; GROUNDCOVER</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>CLAY SOIL</td>
<td>LOAM SOIL</td>
</tr>
<tr>
<td>Emitter Flow</td>
<td>0.26 GPH</td>
<td>0.4 GPH</td>
</tr>
<tr>
<td>Emitter Spacing</td>
<td>18”</td>
<td>12”</td>
</tr>
<tr>
<td>Lateral (Row) Spacing</td>
<td>18” 20” 22”</td>
<td>12” 14” 18”</td>
</tr>
<tr>
<td>Burial Depth</td>
<td>Bury evenly throughout the zone from 4” to 6”</td>
<td>On-surface or bury evenly throughout the zone to a maximum of 6”</td>
</tr>
<tr>
<td>Application Rate (Inches/Hour)</td>
<td>0.19 0.17 0.15 0.64 0.55 0.43 0.98 0.84 0.65 1.48 1.27 1.11</td>
<td>0.19 0.16 0.14 0.30 0.26 0.23 0.73 0.65 0.59 1.11 0.99 0.89</td>
</tr>
<tr>
<td>Time to Apply ¼” of Water (Minutes)</td>
<td>80 89 97 23 27 35 15 18 23 10 12 13</td>
<td>80 93 106 50 58 66 20 23 26 13 15 17</td>
</tr>
</tbody>
</table>

Following these maximum spacing guidelines, emitter flow selection can be increased if desired by the designer. 0.9 GPH flow rate available for areas requiring higher infiltration rates, such as coarse sandy soils.

Note: 0.4, 0.6 and 0.9 GPH are nominal flow rates. Actual flow rates used in the calculations are 0.42, 0.61 and 0.92 GPH.
Dripline Installation
Line Source Dripline
Convert Sprinklers to Dripline
Point-source Drip

Does not encourage a healthy root system
Point-source Drip

• Drip tubing with individual emitters connected directly or with ¼" spaghetti tubing and fittings
  • ¼" tubing is more prone to UV-damage and foot-traffic damage

• Wide variety of emitter designs with different characteristics

• Flow rates: ½, 1, 2, 4, 6, and 10 GPH
Point-source Drip

• Pressure regulate per specifications to avoid emitters being blown off
• Place multiple emitters at edge of plant canopy not at base of trunk
• Use the number of emitters appropriate to plant size and water needs
• Pressure-compensating emitters ensure uniform water application over long runs and elevation changes
Bubbler & Micro-sprays

- Low-volume bubblers apply water in a small radius
  - Flow rate: 0.25-2.0 GPM (15-120 GPH)
    - many time higher than point-source emitters
  - Useful for isolated large shrubs and trees

- Micro-sprays apply water in a fine spray
  - Flow rate: 0.25-30 GPH
  - Radius larger than bubbler and much less efficient

- Soaker hose and laser tubing are not recommended
Water-efficiency Features

• Matched-precipitation features (MPR) emission devices improve distribution uniformity

• Check valves keep water in the irrigation lines
  • Reduce water lost due to low-head drainage

• Pressure regulators compensate for high or fluctuating pressure

• Pressure-compensating emitters ensure an even flow at all emitters
Distribution Uniformity (DU)

- Can only be determined by performing an audit
  - A perfectly uniform application would give a DU of 100%.
  - Sprinkler systems average DU of 35 to 50%
  - Dripline systems average 80-90% uniformity
Irrigation Practices to Avoid

• Operating pressures below or above manufacture's recommendations
• Unmatched-precipitation rate nozzles
• Mixed types of emission devices
  • Dripline with micro-sprays
  • Fixed sprays with rotating sprinklers
• Emission devices with uneven or unknown application rates
  • Soaker hose, laser tubing
• Plant material blocking overhead sprays
• Drip emitters placed at the base of plant stem or trunk
Irrigation Maintenance & Troubleshooting

• Irrigation Controller Check-up
  • Check date and time and reset if needed
  • Replace battery back up
Irrigation System Check-up

- Manually activate valves
  - Look, listen, feel
  - Flag trouble spots
  - Fix the problem
    - Stuck Valves
    - Clogged nozzles
    - Readjust arcs
    - Readjust heads
    - Replace wiper seals
    - Broken lines
    - Plugged emitters
    - Missing emitters
- Use identical parts
Irrigation System Check-up

- Prune or move plants blocking sprays
Irrigation System Check-up

- Water Pressure Issues
  - **Low Pressure**
    - Poor pattern
    - Heads don’t pop-up or only partially
    - Last head may not spray at all
  - **High Pressure**
    - Misting
    - Blowing nozzles
Excessive Water Pressure

Water Hammer: occurs when the flowrate of fluid in the pipe changes rapidly

- Can cause burst pipes, damaged supports and pipe racks, and leakage at joints.
- The higher the water pressure, the greater the water hammer danger. If your water pressure is over 80 PSI, reduce your maximum flow by 20%

Scrubbing: high water velocity scrubs molecules loose from the inside of the pipe wearing it away enough that the pipe develops a leak

- The higher the velocity, the more scrubbing occurs
Excessive Water Pressure

- **Water Hammer**: occurs when the flowrate of fluid in the pipe changes rapidly
  - Can cause burst pipes, damaged supports and pipe racks, and leakage at joints
  - The higher the water pressure, the greater the water hammer danger.
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- **Scrubbing**: high water velocity scrubs molecules loose from the inside of the pipe wearing it away enough that the pipe develops a leak
  - The higher the velocity, the more scrubbing occurs
Measure Water Pressure

• Water pressure - the energy that powers your sprinkler system
  • it will make your sprinklers do the “rain dance”.
  • ignore it, it can bite you hard in the wallet!

• PSI = pounds per square inch
  • Call your water supplier and ask what the “static water pressure” at your address.
  • If given a pressure range, i.e., 40-60 PSI, use the LOW number
  • OR, measure using a pressure gauge that attaches to a hose bib at the house
Check Drip Pressure
Pressure Regulators (PR)

- Pressure regulators are commonly set within a range of 50 and 65 PSI
- Generally located at the house
- Irrigation system typically comes off the mainline before the PR
Measuring Water Pressure with a Gauge

**Measure**

Static pressure: measure with no water moving

**Turn off**

Turn off everything that uses water in your home: faucets, ice makers, toilets, etc.

**Attach**

Attach gauge to a water outlet (hose bib will do) at about the same height (elevation) as the tap for the irrigation system supply

**Turn on**

Turn on valve the gauge is connected to allowing water to enter the gauge

**Read**

Read pressure on the gauge
Measure the Maximum Available Flow (GPM)

• Flow is the companion of water pressure (PSI)
• Flow is the measure of how much (volume) water is moved in a given amount of time measured in Gallons per Minute (GPM)
  • Remember: Pressure is the “energy” that moves the water through pipes
• Determine the size of the water supply pipe
  • Measure how many inches of string it takes to go around the pipe once
  • \( \frac{C}{\pi} = D \) (circumference / 3.14 = diameter)
  • Search outside diameter (OD) of SCH 80 PVC or copper pipe
    • \( \frac{3}{4}'' = 1.05'' \) OD SCH 80 PVC
    • 1'' = 1.315'' OD SCH 80 PVC
    • \( \frac{3}{4}'' = 0.875'' \) OD Copper pipe
<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Steel Pipe</th>
<th>Copper Pipe</th>
<th>PVC Pipe</th>
<th>PE (poly) Tube</th>
<th>PEX (CTS) Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot;</td>
<td>6 GPM(7 ft/sec)</td>
<td>6 GPM(7 ft/sec)</td>
<td>6 GPM(7 ft/sec)</td>
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<td>52 GPM(5 ft/sec)</td>
<td>52 GPM(5 ft/sec)</td>
<td>-</td>
</tr>
</tbody>
</table>
Develop a Water Budget

• Calculate your water need (not to exceed amount)

• Tools:
  • EPA WaterSense Water Budget Tool
  • Simplified Landscape Irrigation Demand Estimation (SLIDE)
Sources of ETo

• Weather stations measure:
  • Solar radiation
  • Soil temperature
  • Air temperature
  • Relative humidity
  • Wind speed & direction
  • Precipitation
CIMIS Map – Sacramento Region

https://cimis.water.ca.gov/ Stations.aspx
Irrigation Audits

- Find out how fast the water is being applied
- Find out how evenly the sprinklers are covering their area (DU)
- Both of these values are used to calculate the irrigation schedule
- The information is used to determine the need for repairs and upgrades
Water Conservation Strategies for Irrigation

• Watering
  • Water at night or early morning
  • Do not water in high wind
  • Avoid or reduce overspray
  • Water less frequently, but deeply
    • Practice water cycling as needed
  • Gradually reduce water application – 10% at a time
  • Manage irrigation to match microclimates

• Encourage development of extensive root system
Capturing & Utilizing Water
Irrigation Alternatives to Municipal Drinking Water

- On-site, non-potable water resources
  - Rainwater harvesting
  - Greywater
  - Air-conditioner condensate
Active Rainwater Harvesting

- Barrels
- Cisterns
- Tanks
Rain Gardens

• Capture water – slow, spread, sink
• Not a pond - holds water just long enough for it to percolate into the soil
• Equivalent of home bioretention basins
  • plants and soil microorganisms break down and remove pollutants such as phosphorus, nitrogen, heavy metals and hydrocarbons
• Collect water from high points letting gravity move it to a downslope natural depression or flat area where a depression can be created
• Providing habitat for insects and birds
• Providing a place to plant interesting stream and pond-side plants
• Deep watering your garden’s trees and shrubs (in winter/spring in our area)
• Adds an aesthetic landscape feature with many planting and design possibilities
• Groundwater recharge
Rain Garden
• Site the garden at least 10 feet away from any structures and 5 feet from property lines

• Do not site in soils with high water tables or clay soils without an overflow device
Swales

- Shallow channels designed to SLOW, SPREAD and SINK water during low flows
- Can meander or be a straight alignment
- The geometry of meandering swale maximizes the time water spends in the swale aiding the trapping of pollutants and sediments while promoting infiltration
- Two types of swale systems:
  - Vegetated
  - Rock-lined aka dry creek beds
Underground Rainwater Storage
Underground Water Storage
Underground Rainwater Storage
Rainwater Collection Calculations

- ~600 gallons of per each inch of rain falling on a 1,000 square feet of roof
- Different surface materials have varying rates of runoff
  - Metal roof vs. Composition shingles
Greywater

- Typical U.S. household generates an average of 35 gallons of greywater per person per day
- Requires use of landscape-friendly detergents and other cleaning agents
- 50 to 80% of residential “wastewater” is dish, shower, sink, and laundry water
Greywater Action

UPCOMING EVENTS

Greywater Workshop (Ashland, OR)
July 27 @ 9:30 am - 4:00 pm

Hands-on Greywater Workshop (Eugene, OR)
August 4 @ 10:00 am - 3:00 pm

Greywater Installer’s Course (5 day, Los Angeles)

California Greywater Regulations

California’s greywater code is found in Chapter 15 of the California Plumbing Code (CPC) (as of 2017, previously it was in Chapter 16). Under the current code washing machine systems can be constructed without a permit in single family homes (1 or 2 units), so long as 13 guidelines are followed (see below). Other types of systems require a permit in the state.

You can download the greywater chapter here. Note that Chapter 15 includes regulations for both “HCD” – the residential code, and “BSC” – the commercial code. If you are building a system in a residential home disregard any requirements that start with “BSC”.

Permeable Paving
Permeable Paving

Driveways, walks and patios
Plants: What & Where
Water-wise Landscapes

Don't have to look like cactus gardens or moonscapes!
Existing Landscapes:  
Prioritize Your Plants

• **High Priority**: trees and shrubs
  • Leave large, mature shade trees and shrubs alone unless they are declining

• **Medium to High Priority**: perennials, fruit and nut trees, small fruits and vegetables

• **Low Priority**: annual flowers and herbs, ornamental grasses, turf
Existing Landscapes

- Compost and mulch to increase soil water-holding capacity
- Modify irrigation to water less frequently but more deeply
- Consider removing and replacing plants that show stress when water is cut back
- Do not fertilize, especially in summer
- Right plant, right place
New Landscaping or Renovation

- Rescape (previously EcoLandscape California) offers model landscape plans
Eco-Friendly Landscape Design Plans for The New California Landscape

Capture and manage water on site
- Rain garden & rain chains
- Dry creek bed
- Permeable materials
- Meadow-like garden year-round color
Eco-Friendly Landscape Design Plans for The New California Landscape

Small scale bountiful beauty
Lower maintenance
Tidy, low-water-use plants
Easy-care, resource-efficient lawn
Recycled & repurposed materials
Eco-Friendly Landscape Design Plans for The New California Landscape

Worthy of National Wildlife Federation designation
Provides water, shelter & food for wildlife
Variety of features for the entire family—Connects children with nature
Edible garden
Abundance of textures & colors
Eco-Friendly Landscape Design Plans for The New California Landscape

Something for everyone
Sophisticated style
Park-like front yard
Entertainment extravaganza back yard
Vibrant, colorful plant palette
Calflora.org: What Grows Here

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
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<tbody>
<tr>
<td>Annual Herb</td>
<td>635</td>
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<tr>
<td>Perennial Herb</td>
<td>550</td>
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<tr>
<td>Grasslike</td>
<td>188</td>
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<tr>
<td>Shrub</td>
<td>243</td>
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<tr>
<td>Tree</td>
<td>123</td>
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<tr>
<td>Vine</td>
<td>53</td>
</tr>
<tr>
<td>Fern</td>
<td>28</td>
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</table>
Amelanchier alnifolia, a dicot, is a shrub that is native to California, is also found outside of California, but is confined to western North America.

Wetlands: Occurs usually in non-wetlands, occasionally in wetlands.
Calscape.org

- Advanced Search
### Advanced Search

Select desired plant characteristics and then click 'Search' to see matching plants.

<table>
<thead>
<tr>
<th>Native To</th>
<th>California</th>
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<tbody>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>- Annual herb</td>
<td></td>
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<tr>
<td>- Fern</td>
<td></td>
</tr>
<tr>
<td>- Grass</td>
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<tr>
<td>- Perennial herb</td>
<td></td>
</tr>
<tr>
<td>- Shrub</td>
<td></td>
</tr>
<tr>
<td>- Succulent</td>
<td></td>
</tr>
<tr>
<td>- Tree</td>
<td></td>
</tr>
<tr>
<td>- Vine</td>
<td></td>
</tr>
<tr>
<td>Sun</td>
<td></td>
</tr>
<tr>
<td>- Full Sun</td>
<td></td>
</tr>
<tr>
<td>- Part Shade</td>
<td></td>
</tr>
<tr>
<td>- Full Shade</td>
<td></td>
</tr>
<tr>
<td>Drainage</td>
<td></td>
</tr>
<tr>
<td>- Fast</td>
<td></td>
</tr>
<tr>
<td>- Medium</td>
<td></td>
</tr>
<tr>
<td>- Slow</td>
<td></td>
</tr>
<tr>
<td>- Standing</td>
<td></td>
</tr>
<tr>
<td>Water Requirement</td>
<td></td>
</tr>
<tr>
<td>- Extremely Low</td>
<td></td>
</tr>
<tr>
<td>- Very Low</td>
<td></td>
</tr>
<tr>
<td>- Low</td>
<td></td>
</tr>
<tr>
<td>- Moderate - High</td>
<td></td>
</tr>
<tr>
<td>Ease of Care</td>
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<tr>
<td>- Very Easy</td>
<td></td>
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<td>- Moderately Easy</td>
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<td>- Fairly Difficult</td>
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<tr>
<td>- Very Difficult</td>
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<td>Common Uses</td>
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<tr>
<td>- Bank Stabilization</td>
<td></td>
</tr>
<tr>
<td>- Bee Gardens</td>
<td></td>
</tr>
<tr>
<td>- Bird Gardens</td>
<td></td>
</tr>
<tr>
<td>Common Uses</td>
<td></td>
</tr>
</tbody>
</table>

### Availability in Nurseries

- Commonly Available
- Sometime Available
- Rarely Available
- Never, or Almost Never Available
- Available Through Seed Stores

### Nurseries

- 3 Rivers Blooms
- Ackerman Native Plant Nursery
- Annels' Annuals and Perennials
- Antelope Valley Resource Conservation Nursery
- Artemisia Nursery
- Aspen Hollow Nursery
- Back to Native Nursery @ Santiago Park
- Bay Natives
- Baylands Nursery
- Belmont Nursery
- Berkeley Horticultural Nursery
- Beeson Hill California Native Plants
- Ch. Norcutt Plant Nursery

### Fragrance

- Fragrant - Pleasant
- Fragrant - Unpleasent
- None
- Slight

### Flower Color

- Black
- Blue
- Brown
- Cream
<table>
<thead>
<tr>
<th>Fragrance</th>
<th>• Fragrant - Pleasant</th>
<th>• Fragrant - Unpleasant</th>
<th>• None</th>
<th>• Slight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flower Color</td>
<td>• Black</td>
<td>• Blue</td>
<td>• Brown</td>
<td>• Cream</td>
</tr>
<tr>
<td>Flowering Season</td>
<td>• Spring</td>
<td>• Summer</td>
<td>• Fall</td>
<td>• Winter</td>
</tr>
<tr>
<td>Height</td>
<td>-</td>
<td>Feet</td>
<td>Inches</td>
<td></td>
</tr>
<tr>
<td>Genus</td>
<td></td>
<td></td>
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<td></td>
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</table>
Turf Selection
Water Conservation Strategies for Turf

- Mowing strategies
  - Frequency of mowing affects ET
    - Tall grass = high ET
  - Mow at tallest recommended height for type of grass
  - Mowing when hot or dry can injure plants
  - Mow less frequently at a taller height

<table>
<thead>
<tr>
<th>Turfgrass species</th>
<th>Cutting Height range (inches)</th>
</tr>
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<tbody>
<tr>
<td><strong>Cool season turfgrasses</strong></td>
<td></td>
</tr>
<tr>
<td>creeping bentgrass</td>
<td>0.2-0.5</td>
</tr>
<tr>
<td>colonial bentgrass</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>red fescue</td>
<td>1.0-2.0</td>
</tr>
<tr>
<td>Kentucky bluegrass</td>
<td>1.5-2.5</td>
</tr>
<tr>
<td>perennial ryegrass</td>
<td>1.5-2.5</td>
</tr>
<tr>
<td>tall fescue</td>
<td>1.5-3.0</td>
</tr>
<tr>
<td><strong>Warm-season turfgrasses</strong></td>
<td></td>
</tr>
<tr>
<td>bermudagrass</td>
<td>0.5-1.0</td>
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<tr>
<td>zoysiagrass</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>seashore paspalum</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>St Augustinegrass</td>
<td>0.5-1.5</td>
</tr>
<tr>
<td>kikuyugrass</td>
<td>0.5-1.0</td>
</tr>
</tbody>
</table>
Lawn Alternatives

• Grassland mix (Delta Bluegrass)

• *Agrostis pallens* - native bent grass lawn
Lawn Alternatives

- Koeleria macrantha natural
- Koeleria macrantha mown
Lawn Alternatives

- Festuca rubra mown
- Festuca rubra long
Lawn Alternatives

• Carex pansa natural

• Carex pansa mown
For Slopes

- Festuca idahoensis
- Festuca rubra
- Native mix (Delta Bluegrass)
Resources

Native & Drought-tolerant Plants

• CNPS – What Grows Here? https://www.calflora.org/entry/wgh.html

• Eco-Friendly Landscape Design Plans for the New California Landscape: www.ecolandscape.org/new-ca/

• River Friendly Inspiration Garden: http://www.ecolandscape.org/riverfriendly/topics/inspiration-garden.html

• The Regional Water Authority's Water-Wise Gardening software: http://www.rwa.watersavingplants.com/

• The UC Davis Arboretum All-Stars: http://arboretum.ucdavis.edu/arboretum_all_stars.aspx
Resources (cont.)

• Native plants for Northern California: https://www.wildflower.org/collections/collection.php?collection=CA_north

• The Bay Area Bringing Back the Natives website includes useful information on using California natives in the landscape.

• California plant database search tool — www.waterwonk.us
Additional Resources and Citations

• **Water Storage**
  - California Water Myths: [https://www.ppic.org/content/pubs/report/R_1209EHR.pdf](https://www.ppic.org/content/pubs/report/R_1209EHR.pdf)
  - Rain Gardens: [http://www.waterwisesb.org/asset.c/289](http://www.waterwisesb.org/asset.c/289)

• **Lawn Alternatives**
UCCE
El Dorado County
Master Gardeners

Contact us:
530-621-5512 (Tues-Fri 9:00AM-Noon)
mgeldorado@ucdavis.edu
Visit us at 311 Fairlane, Placerville