Designing Water-Wise Irrigation Systems

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Challenge of Landscape Irrigation

**Landscape irrigation**
- Different types of plants
- Different ages
- Different sizes/heights
- Varying planting density
- Varying slopes
- Varying soil types

**Agricultural irrigation**
- One type of plant (crop)
- Same age
- Same size
- Same planting density
- Grown on level ground
- Same soil type
The moral of the story is...

Don’t use uniform watering strategies with non-uniform plant material
Irrigation Legend

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
<th>Pressure</th>
<th>Flow</th>
<th>Rotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprinklers</td>
<td></td>
<td>0.37 gpm</td>
<td>13.5 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.43 gpm</td>
<td>13.5 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.19 gpm</td>
<td>13.3 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.51 gpm</td>
<td>10.5 ft</td>
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<td></td>
<td></td>
<td>0.73 gpm</td>
<td>12.5 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.33 gpm</td>
<td>8 ft</td>
<td></td>
</tr>
<tr>
<td>Meters/Pumps</td>
<td>3/4 inch meter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backflow Device</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Valve</td>
<td>Hunter PDC-100G</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y-Strainers/Filters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation Accessory</td>
<td>WeatherTRAK WYLC-C-18-PL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Miscellaneous Manual Flush Valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Miscellaneous Weather 600 Pressure Regulator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nibco 1” isolation valve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lateral Line Pipe</td>
<td>Schedule 40 3/4”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mainline Pipe</td>
<td>Schedule 40 1”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driveway</td>
<td>Netafin TLCV6-18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Netafin TLCV6-18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blank 1/2” polyethylene tubing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. All planted areas are dripped with Netafin TLCV6-18 grid.
2. The line spacing is 18”, and the emitter spacing is 18”.
3. Ensure that all plants have one emitter positioned on the root ball. Use the following as a guide to determine how many emitters each plant gets.
   - 1 gallon plants: 2 emitters
   - 3 gallon plants: 3 emitters
   - 5 gallon plants: 5 emitters
   - 24” box: 7 emitters
4. Ensure that all drip grid lines are run horizontally along contour of slopes.
5. Run blank polyethylene tubing under hardscaping and through areas of no plants.
6. No drip zone shall exceed 4 gallons per minute of flow.
7. All planted areas are drip, and lawns use sprinklers.
8. The drip zones that have lines drawn in mark the positions of the drip tubing. If the lines are not drawn in, this assumes a regular grid of 18” between the lines of the grid, as shown on the details page.
9. Black tubing connecting brown tubing with the valves is blank 1/2” polyethylene tubing.
10. Every drip zone requires at least one manual flush valve. In many zones, several have been indicated. See detail on notes and details page.

See more notes on Notes and Details page.

Professional Irrigation Design
See more at http://www.ecolandscape.org/new-ca/
Designing Irrigation

First perform a site evaluation
Know Your Soil Type

• Soil probe
• Hand test
• Jar test
• Percolation test
• Soil lab for analysis
Know Your Soil Type

**Coarse (Sand):** Soil particles are loose. Squeezed in hand when dry, it falls apart when pressure is released.

Squeezed when moist, it will form a cast, but will crumble easily when touched.
Know Your Soil Type

Medium (Loam): Has a moderate amount of fine grains of sand and very little clay. When dry, it can be readily broken.

Squeezed when wet, it will form a cast that can be easily handled.
Know Your Soil Type

**Fine (Clay):** When dry, may form hard lumps or clods.

When wet, the soil is quite plastic and flexible. When squeezed between the thumb and forefinger the soil will form a ribbon that will not crack.
How Water Moves Through Different Soil Types

Figure 1. Comparative movement of water in sandy and clayey soils
Designing Irrigation

Divide landscape into hydrozones
What Is a Hydrozone?
Learn From Nature
How Many Hydrozones?

- Group by water needs
- Group by sun or shade or wind
- Plants in pots
- Veggie beds
- Fruit trees
- Established planted area
- Trees
This Is a Hydrozone
Water-Use Values
How do I know the water needs

Very Low

Low

Moderate

High
## Plant Search Database

**American Canyon, CA**

34 results. ([Start Over] | [Search Again])

<table>
<thead>
<tr>
<th>Type</th>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Water Use</th>
<th>Select for my List</th>
</tr>
</thead>
<tbody>
<tr>
<td>G N</td>
<td>Aristida purpurea</td>
<td>purple three-awn</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Arundinaria gigantea</td>
<td>cane reed</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>G N</td>
<td>Bothriochloa barbinodis</td>
<td>cane bluestem</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>G N</td>
<td>Bouteloua gracilis and cvs.</td>
<td>blue grama</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Briza media</td>
<td>quaking grass</td>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

[http://ucanr.edu/sites/WUCOLS](http://ucanr.edu/sites/WUCOLS)
### Plant Search

**Location:** American Canyon, CA  
**Region:** WUCOLS Region 1

#### Search Filters
- Botanical name begins with: 
- Common name begins with: 

#### Plant Type
- Bamboo
- Palm
- Shrub
- Grass
- Succulent
- Groundcover
- Tree
- Perennial
- Vine
- California Native

#### Water Use
- Very Low
- Low
- Moderate
- High
- Unknown
- Not appropriate for this region

### Search Results

<table>
<thead>
<tr>
<th>Type</th>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Water Use</th>
<th>Flickr Photos</th>
<th>Select for My List</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>Aristida purpurea</td>
<td>purple three-awn</td>
<td>Low</td>
<td>See it</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Arundinana gigantea</td>
<td>cane reed</td>
<td>Low</td>
<td>See it</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Eriochloa barbinaxis</td>
<td>cane bluestem</td>
<td>Low</td>
<td>See it</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Bouteloua gracilis</td>
<td>blue grama</td>
<td>Low</td>
<td>See it</td>
<td></td>
</tr>
</tbody>
</table>

**Total Plants:** 34

**Type:** Grass  
**Water Use:** Low
Flickr Plant Search

Fremontodendron californicum

www.flickr.com/photos/ericinsf/16678463/
Hydrozoning Example #1
Hydrozoning Example #1
Hydrozoning Example #2
Hydrozoning Example #2
Hydrozoning Example #3
Troubleshoot Plant Problems
Choosing Irrigation Type

Will it be spray or drip?
Spray the Lawn with Efficient Sprinklers
Efficient Sprinkler Nozzles

20% higher efficiency!
Remember:

• Install pressure regulator after the valve, or sprinklers with pressure regulation built in

• Flush system after installing

• Match application rate of nozzles to infiltration rate of soil

• Avoid runoff by using proper scheduling techniques
Two Types of Drip

Emitters placed at the plants – **Point Source** for sparse plantings

Built-in emitters in a grid formation – **Line Source** for dense plantings
Point-Source Drip for Sparse Plantings
Point Source – Sparse Plantings
Drip Grid for Dense Plantings
Line Source (Grid) – Dense Plantings
Convert Sprinklers to Drip Grid
Spray–to–Drip Conversions

Spray-to-Drip Retrofit Kits

Convert Any Spray Zone to a Drip Zone!
The easiest and fastest way to convert a conventional spray zone to a low-volume irrigation zone.

1800-Retro
1800 Series Spray Body that contains a filter, pressure regulator, and 1/2” male threaded outlet

Installation
- Simply remove the top of any 1800 and remove the internal assembly (On the 1806 and 1812 leave the spring in the body)
- Remove the internal assembly of the retro kit and drop into the existing body
- Tighten the cap
- Use Easy Fit Fittings or a female adapter to connect to drip tubing or other 1/2” FPT devices

Features
- Can be installed above or below grade
- Provides 30 psi (2.1 bar) pressure regulation and 200-mesh (75 micron) screen
- Flow rate 0.50 to 4.00 GPM (1.9 to 15.1 l/min)
Don’t Mix These on the Same Zone

Sprinklers

Drip emitters
We don’t Recommend Using... 

Microsprays

Soaker hoses
Drip Guidelines

- Use .25 or .4, or .5 gph emitters in clay soil
- Use .4, .5, or .6 gph emitters in loam soil
- Use .9 or 1.0 gph emitters in sandy soil
  - 240 gph capacity per valve zone (4 gpm)
- Use plant sizes to determine number of emitters, and add more emitters if plants appear to need more water
- Or use Rain Bird online calculator
Number of Emitters: Plants with Same Water Needs

- Plants less than 1 foot in diameter: 1 emitter
- Plants 1 - 2 feet in diameter: 2 emitters
- Plants 3 – 4 feet in diameter: 4 emitters
- Plants 5 – 6 feet in diameter: 8 emitters
Number of Emitters: Plants with Different Water Needs

- Plants less than 1 foot in diameter: 1 emitter (low), 2 emitters (moderate), 3 emitters (high)
- Plants 1 - 2 feet in diameter: 2 emitters (low), 4 emitters (moderate), 8 emitters (high)
- Plants 3 – 4 feet in diameter: 4 emitters (low), 8 emitters (moderate), 16 emitters (high)
- Plants 5 – 6 feet in diameter: 8 emitters (low), 16 emitters (moderate), 32 emitters (high)
TREE EMITTERS - EXAMPLE PLACEMENT

- In-line / Dripperline Emitters

Tree Trunk

New Tree Planting

As tree matures, add emitters depending on tree water requirements (e.g., low or moderate water use).

Drip Line

Drip Line of Immature Tree

Drip Line of Mature Tree

NOTE: - The spacing and number of emitters are examples.
- Specific spacing and number of emitters will depend on plant size at installation, plant water requirements, soil type, and emitter flow rate.

SHRUB EMITTERS - EXAMPLE PLACEMENT

- Point-Source Emitters
- Wetting Pattern

Drip Line

New Shrub Planting

As shrub matures, add and/or move emitters depending on shrub water requirements (e.g., low or moderate).

Drip Compression Fitting "T"

Blank Drip Tubing

Flushing End Cap Assembly

Drip Compression Fitting "End Cap"
Remember:

- Install pressure regulator and filter
- Flush system regularly
- Match application rate of emitters to infiltration rate of soil
- Avoid runoff by using tubing with check valves on slopes
Zone Flow Precaution
Try not to exceed 4 gpm for any zone

### Schedule 40 PVC

<table>
<thead>
<tr>
<th>Flow</th>
<th>Size of PVC Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 gpm - 7 gpm</td>
<td>¾”</td>
</tr>
<tr>
<td>7.1 gpm - 12 gpm</td>
<td>1”</td>
</tr>
<tr>
<td>12.1 gpm - 22 gpm</td>
<td>1 ¼”</td>
</tr>
</tbody>
</table>

### Polyethylene Tubing or Blu-Lock

<table>
<thead>
<tr>
<th>Flow</th>
<th>Size of Tubing</th>
</tr>
</thead>
<tbody>
<tr>
<td>.1 gpm - 4 gpm</td>
<td>½”</td>
</tr>
<tr>
<td>4.1 gpm - 8 gpm</td>
<td>¾”</td>
</tr>
<tr>
<td>8.1 gpm - 12 gpm</td>
<td>1”</td>
</tr>
</tbody>
</table>
Don’t Know the Pipe Sizes?

Google “determine pipe size based on string length”

Source: www.design.orbitonline.com
Irrigation Scheduling

Free app for Sacramento Region
Sacramento Region Smart Irrigation Scheduler

Welcome to the Sacramento Region Smart Irrigation Scheduler

Based on Current Weather

Calculates run-time minutes per week for a single sprinkler or drip zone. See videos

New Features

- Scheduling for drip zones is included.
- Register to save multiple zones & controllers.

City: Sacramento
Zip: 95816
Days per week allowed: 2

Set up Zone

Plant Material
Choose one
- Low Water Use
- Moderate Water Use
- Mixed Plants
- Warm Season Turf
- Cool Season Turf

Exposure
Choose one
- Shade
- Part Sun
- Full Sun

Wind
Choose one
- Very Little
- Moderate
- High

What are my city's restrictions?

Provided with the generous support of Water Forum

www.beyondthederought.com
How much water:

- Any incorporated CA city
- Any time frame
- Any plant material
- Various sizes of plants and planted areas
Who Can Assist You?
Let’s look at the handout

Irrigation Resources
For irrigation design

Online Resources for Irrigation Design Help
Rain Bird Irrigation Design Service
http://www.rainbird.com/homeowner/design/index.htm

Orbit Sprinkler System Designer
http://www.design.orbitonline.com/

Sprinkler Waterhouse Sprinkler System and Irrigation Basics help

Irrigation Stores That Help with Irrigation Design
Sprinkler Service and Supply
5733 Manzanita Avenue, Carmichael
916-331-0240

The Urban Farmer Store, Richmond, CA
http://www.urbanfarmerstore.com/
Will assist you in designing your system
510-524-1604

Professional Irrigation Stores
Ewing Irrigation, Horizon, Normac

Drip Calculators (web apps and software)
Rain Bird, two separate calculators for point source and line source
http://www.rainbird.com/landscape/resources/calculators.htm
Who Can Assist You?
Irrigation stores and manufacturers
Some examples:

- Irrigation Tutorials www.irrigationtutorials.com
- Green Acres Nursery & Supply
- Sprinkler Service & Supply in Carmichael
- The Urban Farmer Store www.UrbanFarmer.com
- Rain Bird Corporation www.RainBird.com
- Professional irrigation stores (Ewing, Horizon, Normac)
Who Can Assist You?

- EcoLandscapers & Green Gardeners  
  [www.ecolandscape.org](http://www.ecolandscape.org)
- Landscape Designers  
  [www.apldca.org](http://www.apldca.org)
- CLCA Water Managers  
  [www.CLCA.org](http://www.CLCA.org)
- CA Turf Replacement Rebates  
  [www.saveourwaterrebates.com](http://www.saveourwaterrebates.com)
- Your water provider!
Let’s practice!
Point Source Example

Sparse plantings: Make sure the emitters are on both sides of plant.

Closed loops provide more pressure and flow.
Dense Zone Line Source (dashed)
1 - Arbutus 'Marina' AM 10 ft.
12 - Arctostaphylos uva-ursi AU 2 ft.
8 - Calamagrostis foliosa CF 2 ft.
1 - Callistemon 'Little John' CLJ 6 ft.
1 - Cercis canadensis CC 18 ft.
1 - Cistus ladanifer CL 6 ft.
6 - Helictotrichon sempervirens HS 4 ft.
4 - Helleborus orientalis HO 4 ft.
7 - Lavandula 'Otto Quast' LO 4 ft.
3 - Muhlenbergia rigens MR 4 ft.
5 - Penstemon heterophyllus PH 2 ft.
1 - Ribes sanguineum RS 8 ft.
1 - Rosmarinus officinalis RO 6 ft.
3 - Salvia 'Bee's Bliss' SBB 6 ft.
15 - Stachys byzantina SB 2 ft.

Sparse Zone - Point Source (solid)
1 - Frangula californica FC 4 ft.
3 - Mimulus aurantiacus MA 3 ft.
9 - Iris douglasiana 'Canyon Snow' ID 2 ft.
3 - Ceanothus 'Marie Simon' CMS 7 ft.

Moderate Water Use
Low Water Use

Soil type: Clay Loam
Let’s use Rain Bird’s online drip calculators:
http://softwarerepublic.com/rainbird/
That’s all, folks!