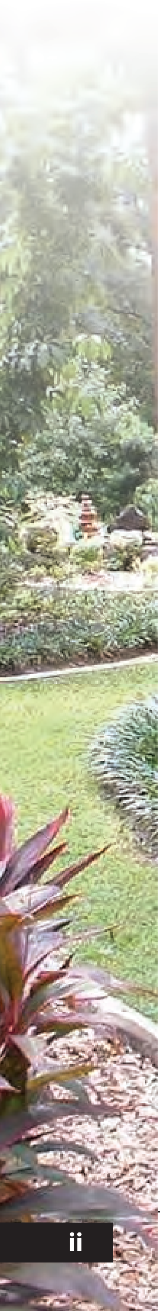
# A Guide to Microirrigation for West-Central Florida Landscapes

*How to save water through proper planning, operation and maintenance.*



# Acknowledgements

Tampa Bay Water wishes to acknowledge the following contributors to version 2 of this guide:

**Dale Armstrong**
Florida-Friendly Landscaping™ Program, Pinellas County

**Lynn Barber**
Florida-Friendly Landscaping™ UF/IFAS Hillsborough County Extension

**Dave Bracciano**
Tampa Bay Water

**Chris Claus**
City of St. Petersburg Water Resources Department

**Norman Davis**
Hillsborough County Public Utilities

**BJ Jarvis**
Pasco Extension Director/Horticulture Agent

**Kirstan Lane**
Tampa Bay Water

**Skip Wright**
Florida Irrigation Society

*The design, layout and publication of this handbook was provided by Tampa Bay Water.*

# Preface

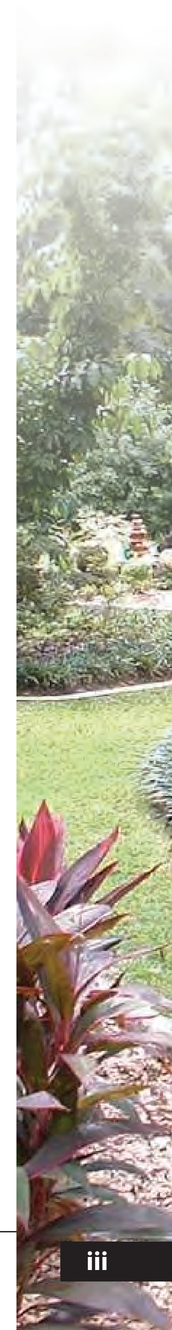
In the Tampa Bay region, it is estimated that at least 70 percent of existing single-family homes and the majority of new homes have in-ground irrigation systems. As the population of west-central Florida grows and the building of new homes continues, the installation and use of automatic in-ground irrigation is expected to increase. Expanding the use of microirrigation in existing and newly installed irrigation systems is considered a key factor in increasing irrigation efficiency.

In 2001, the Florida Legislature declared Florida-Friendly Landscape installation and maintenance practices to be an essential element in conserving the state's water resources. The law was then revised to prevent any deed restriction or covenant entered after October 1, 2001, from prohibiting the installation of Florida-friendly, water-efficient landscapes. Local governments were also instructed to consider the adoption of water-efficient landscaping ordinances that include techniques such as microirrigation. Many local governments in west-central Florida have elected to develop and implement water-efficient irrigation and landscape ordinances.

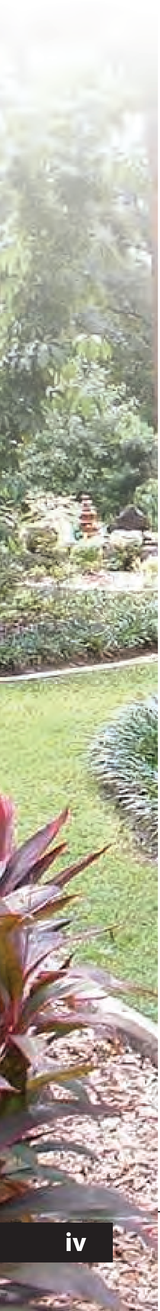
This guide was developed to educate and inform the public about the design, installation, use and maintenance of efficient microirrigation systems in west-central Florida. For more information, please contact a licensed irrigation contractor with microirrigation experience, the Florida Irrigation Society, your local county Extension Service or your water utility (see page 52 for contact information).

*Version 2 - 2013*

*This information will be made available in accessible formats upon request.*
*Please contact Tampa Bay Water at 727.796.2355 or 813.996.7009*
*www.tampabaywater.org*

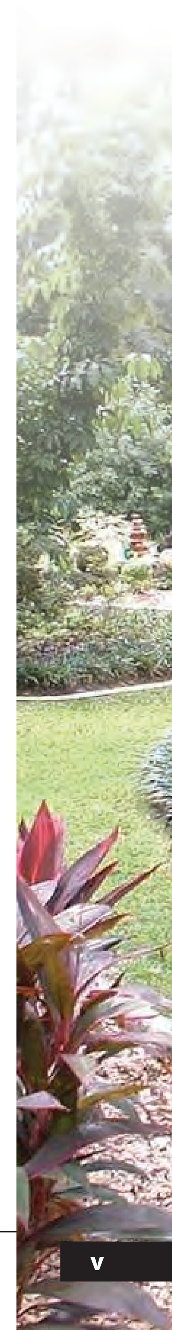


# Table of Contents

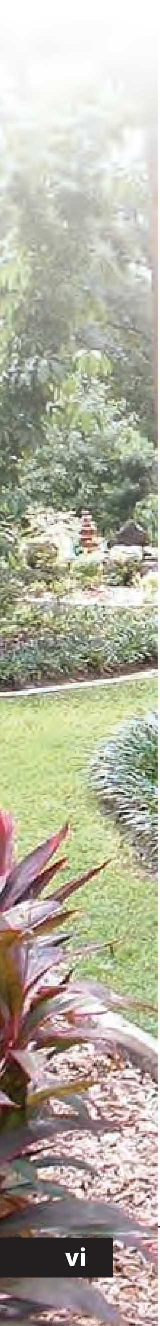


# Table of Contents





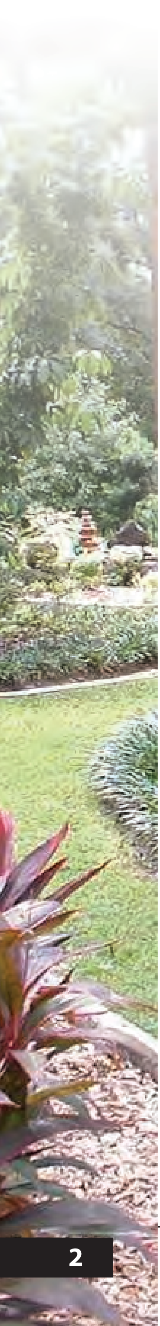
# Table of Contents



# 1 Introduction

**Microirrigation**, commonly referred to as "drip" or "low-volume" irrigation, offers a way to maintain or improve **landscape** quality while saving water. Originally developed in the United Kingdom after World War II, microirrigation is used extensively by farmers in Israel and the United States to grow agricultural and ornamental crops and is increasingly being used in traditional landscape applications. In many regions worldwide where water is scarce, it provides an opportunity for crop production.

When designed and used correctly, microirrigation can improve the efficiency of landscape **irrigation** through the precise application of water. Microirrigation **emitters** have a maximum **flow rate** of 30 gallons per hour (gph), or 0.5 gallons per minute (gpm). In contrast, traditional spray and rotor sprinklers can apply water at a rate of over 3 gpm. Used for landscape irrigation and potted plants, microirrigation is generally not recommended, and in some places prohibited, for use on Florida lawns.



## 1.1 Benefits of Microirrigation

With proper design, operation and maintenance, microirrigation systems can have many benefits, including

- Decreased water loss from evaporation, wind and **runoff**
- Minimized pest problems, such as weeds and diseases, by applying water to the root area of the plant
- Increased water application efficiency when **retrofitting** in-ground sprinkler systems
- Easy connection to hoses or outdoor spigots
- Flexibility in meeting variable water needs of new, maturing and established plants
- Minimized **erosion** when watering plants on steep slopes
- Compliance with local water conservation codes and ordinances

## 1.2 Florida-Friendly Landscaping™

The Florida-Friendly Landscaping™ (FFL) Program was developed by government agencies and the University of Florida's Institute of Food and Agricultural Sciences Extension Program. FFL is designed to educate residents about **Florida-Friendly Landscaping™**, design and maintenance practices that promote and conserve Florida's natural resources. Florida-friendly landscapes incorporate the principle of efficient irrigation in an effort to reduce stormwater runoff and erosion while conserving water. Because water is directed at the roots of the plants, where it is needed most, microirrigation is an important component of a Florida-friendly landscape.

## The Florida-Friendly Landscape Ethic

Through the FFL Program, concerned stakeholders learn about the following Florida-Friendly Landscaping™ principles:

**1** ***Right Plant, Right Place***

Plants suited to a site's specific conditions will usually require less water, fertilizer and pesticides.

**2** ***Water Efficiently***

Irrigate only when your lawn and landscape need water. Efficient watering is one way to have a healthy Florida yard and conserve limited water resources.

**3** ***Fertilize Appropriately***

Less is often best. Over-utilization of fertilizers can be hazardous to your yard and the water quality of our bays, rivers, lakes and streams.

**4** ***Mulch***

Maintaining a 3-inch layer of mulch will help retain soil moisture, suppress weeds, prevent erosion and moderate soil temperatures.

**5** ***Attract Wildlife***

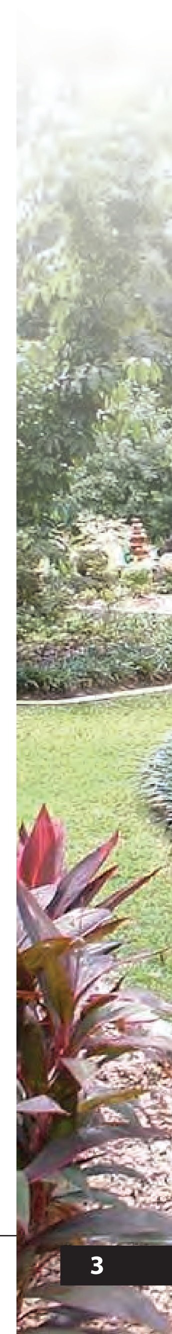
Plants in your yard that provide food, water and shelter can sustain Florida's diverse wildlife.

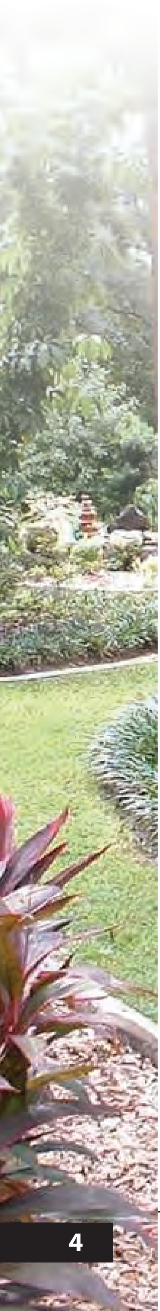
**6** ***Manage Yard Pests Responsibly***

Wise use of pesticides will not harm people, pets, beneficial organisms and the environment.

**7** ***Recycle***

Grass clippings, leaves and yard trimmings recycled on site provide nutrients to the soil and reduce waste disposal.





## 8 *Reduce Stormwater Runoff*

Water running off your yard can carry pollutants, such as soil, debris, fertilizer and pesticides, that can adversely impact water quality. Reduction of this runoff will help prevent non-point source pollution.

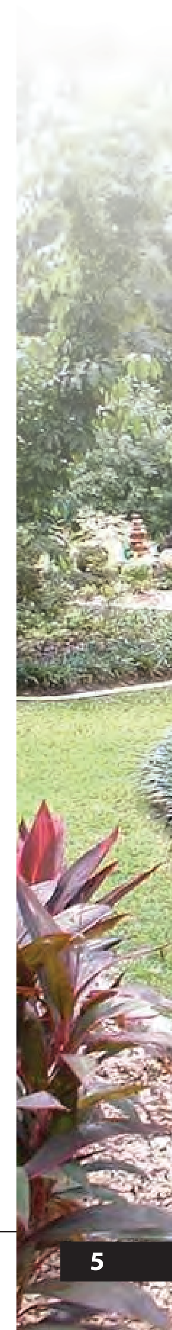
## 9 *Protect the Waterfront*

Waterfront property, whether on a river, stream, pond, bay or beach, is very fragile and should be carefully protected to maintain freshwater and marine ecosystems.

Even small changes in landscape practices will collectively make a dramatic difference in water quality and quantity that will benefit all. This difference will come in the form of a revitalization of our waterways and the preservation of our precious drinking water supplies for generations to come — while at the same time saving FFL participants time, energy and money!

***Florida-Friendly Landscaping™ Tip!***

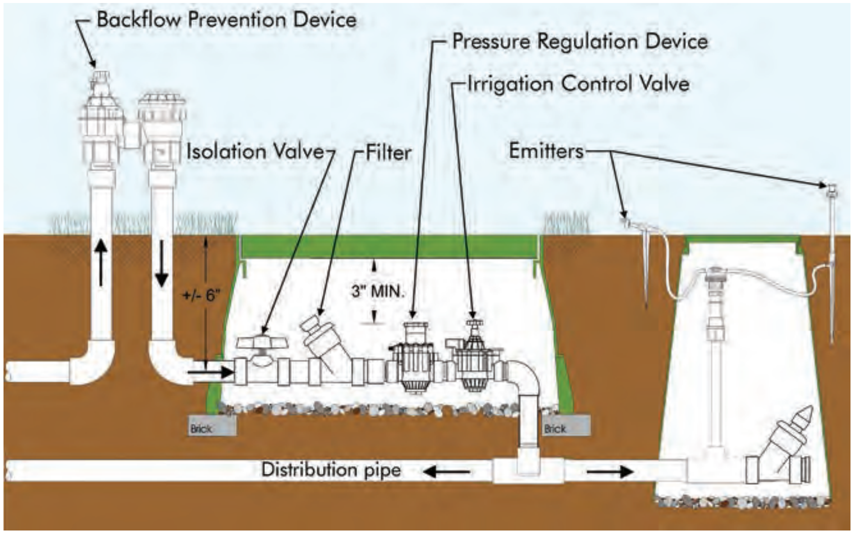
Be sure to look for boxes titled "Florida-Friendly Landscaping™ Tip!" throughout this guide. They will help you learn more about Florida-Friendly Landscaping™ practices that may save you time and money while helping the environment!



# 2 Components of Microirrigation Systems

Microirrigation systems can differ with each installation, but many of the components are common to all systems. This section provides examples of common components and their purposes. Section 3.4 provides important design and installation information.

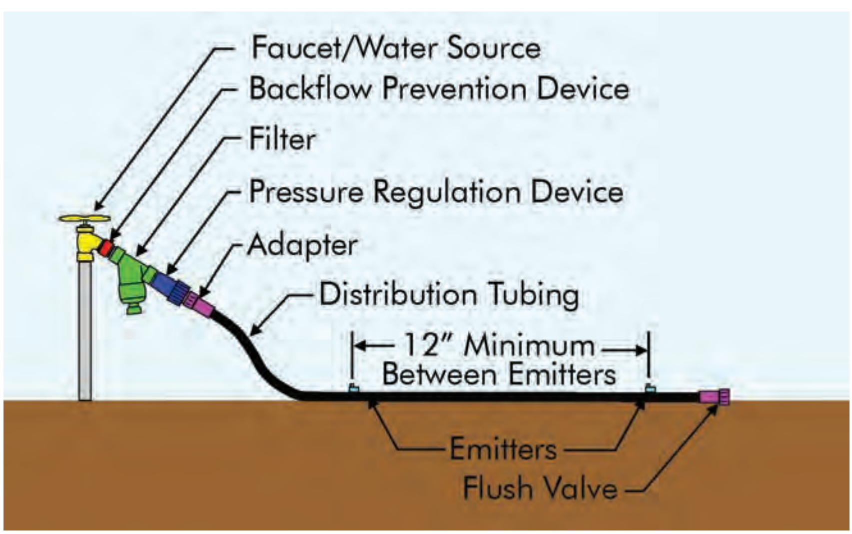
Figure 2.1




A. Gray, Tampa Bay Water

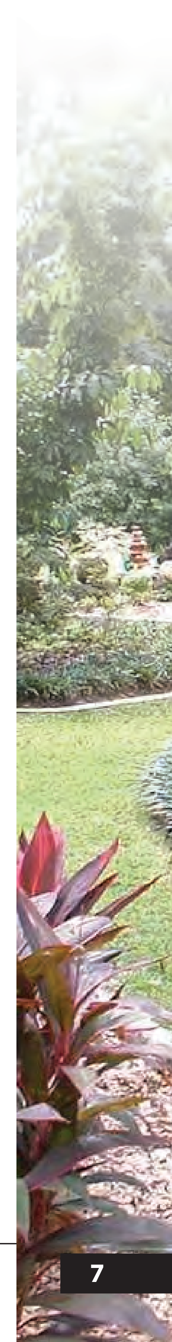
In-Ground System Components

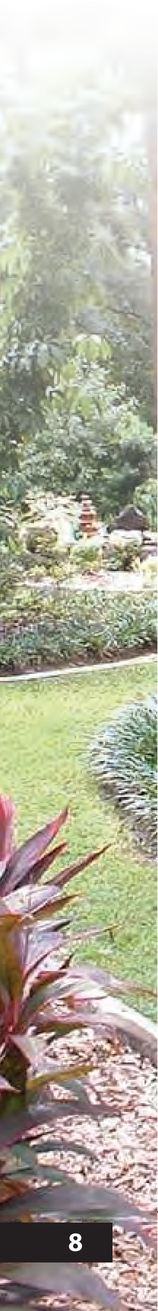
Figure 2.2




A. Gray, Tampa Bay Water

Hose-End System Components





## 2.1 Common Components

Common components in this section are listed in order of installation.

Backflow Prevention

**Backflow Prevention Devices** protect public health and safety by preventing water system contamination and pollution. These devices are installed after the point of connection to the water source and are required on all irrigation systems connected to a public drinking water system. Contact the local municipality to verify backflow prevention requirements for all water sources before installing or retrofitting an irrigation system. If a microirrigation system is connected to a hose, a backflow prevention device should be attached between the hose and the water source.

Isolation Valve

**Isolation Valves** provide a manual shutoff function that allows users to clean the filter and maintain the system. Ball valves are commonly used and are normally installed between the backflow prevention device and the filter. Water faucets perform this function on hose-end systems.


Filters

**Filters** remove particles from water to minimize clogging, which is one of the most common causes of microirrigation emitter failure. A filter should be installed prior to any pressure-regulating device in an accessible location for ease of maintenance. Filters should be selected based on emitter flow rates. The higher the mesh filter number, the smaller the size of the particles captured by the filter.

- 200 mesh filter/75 microns – for 0.5 gph emitters
- 150 mesh filter/100 microns – for 1.0 gph and larger emitters
- 120 mesh filter/125 microns – for drip tubing with 0.6 and 0.9 gph emitters.


**Pressure-Regulating Device**

## Pressure-Regulating Devices

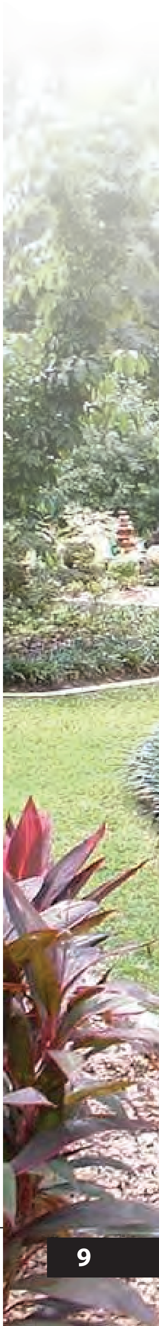
reduce incoming water pressure and help prevent rupturing of plastic tubing and connections. Installation of pressure-regulating devices is recommended since most traditional irrigation systems operate at higher pressures than microirrigation. They are located after the filter and prior to the **distribution tubing**.

## Irrigation Control Valves

open and close, allowing water to enter a specific area of an irrigation system. The type of irrigation control valve used depends on whether an irrigation controller is used. Some older systems are operated using manual valves that are opened and closed by the user.

**Manual Valve**

**Automatic Valve**



Common types of manual valves include gate and ball valves. Most new systems utilize automatic irrigation valves wired to an irrigation system controller. Each zone in an automatic irrigation system requires an automatic valve that opens and closes when signaled by the system's irrigation controller.

## Irrigation Controllers

**Irrigation Controllers** (also known as a time clock or timer) manage the duration and frequency of watering cycles. When properly set, an irrigation controller can make system operation easier and help prevent overwatering.

### *Types of Irrigation Controllers*

**Faucet or spigot-mounted controllers** are used on hose-end watering systems to control the duration and frequency of the zone operation.

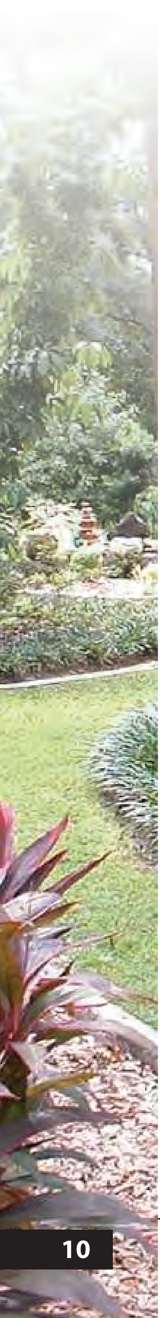
Spigot-Mounted Controller

**Single-valve controllers** (battery-operated) are used where electrical service is not available.

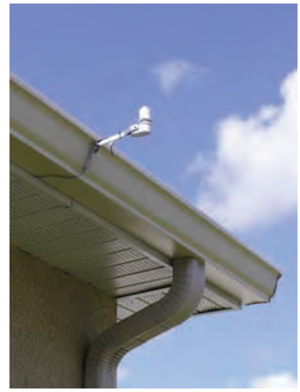
Single-Valve Controller

**Multiple-valve controllers** signal irrigation valves to open and close in sequence to irrigate specific areas of the landscape. A variety of features are available offering flexibility in scheduling and operation.

Multiple-Valve Controller



**Rain sensors and soil moisture sensors** are technologies that inhibit or interrupt operation of an automatic irrigation system when there is sufficient moisture. Under Florida Law (F.S. 373.62) all automatic irrigation systems are required to have one of these devices properly installed, maintained and in operation.



Rain Sensor Device

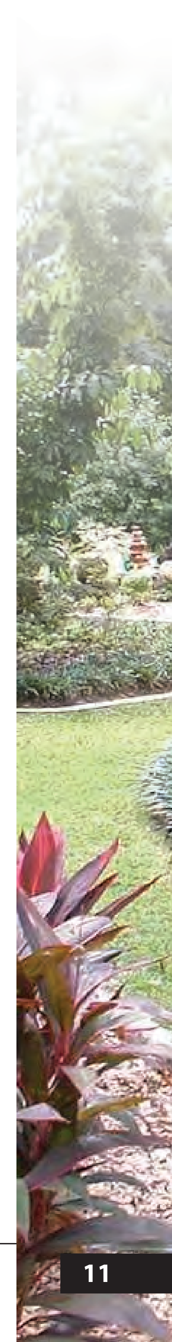
Soil Moisture Sensor Installed

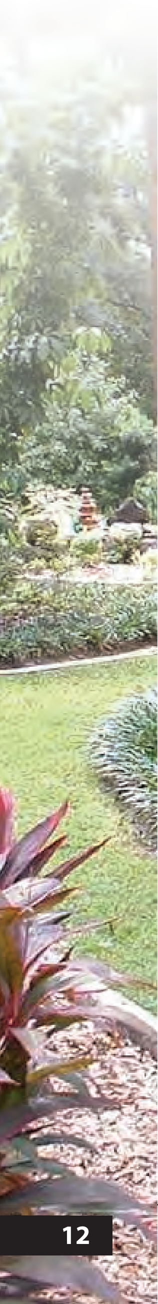
Distribution and Spaghetti Tubing

**Distribution tubing** delivers water from the supply connection to the plant area. Flexible polyethylene (poly) tubing, placed on or below the ground surface, is commonly used.

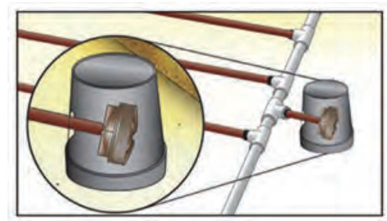
**Spaghetti Tubing** is used to connect most drip and micro-spray emitters to distribution tubing, which allows greater flexibility in emitter placement.

Distribution and Spaghetti Tubing





**Flush valves** allow the user to periodically flush the system of sediment, **algae** and mineral deposits that can accumulate over time. There are two types of flush valves – automatic or manual. Either can be installed at or near the end of the distribution system. As an alternative to installing a flush valve, the end of the distribution tubing or in-line drip tubing can be fitted with a hose-end clamp that crimps the tubing, stopping water flow. This clamping device can then be removed to allow for system flushing.



Flush Valve

Automatic Flush Valve

Manual Hose-End Clamp

***Florida-Friendly Landscaping™ Tip!***

Microirrigation is recommended for use in landscaped beds, not for lawns. Lawn areas should be watered separately from landscaped areas.

## 2.2 Emitter Types and Uses

Microirrigation emitters deliver water at rates between 0.5 and 30 gph. Emitter selection depends on plant arrangement/spacing and owner preference. The following is a description of common emitter types and typical uses:

### In-Line Drip Tubing

#### *Uses*

- Large groupings of plants with similar water needs in a grid pattern
- Single rows and narrow planting beds, such as along fences or in planter boxes

#### *Advantages*

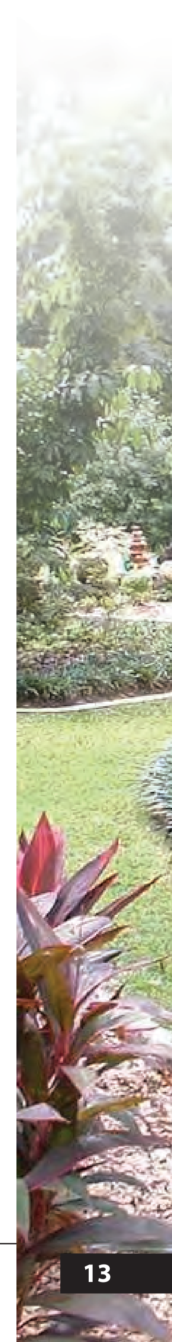
- Easy to install on or in mulch
- Preinstalled emitters are self-cleaning
- Pressure-compensating emitters may be built into tubing, providing a uniform watering rate
- Few parts used
- Water is not sprayed into the air where it could be subject to wind drift and evaporation

#### *Disadvantages*

- Can be easily cut by gardening tools
- Difficult to determine if emitters are clogged or tubing is kinked

***Florida-Friendly Landscaping™ Tip!***

Some plants are susceptible to pests or diseases because of sensitivity to water on their leaves. In these cases, drip emitters and/or in-line drip tubing would be more effective than micro-sprays.



## Drip Emitters

### *Uses*

- Potted plants or hanging baskets
- Patio plants
- Planter beds

### *Advantages*

- Easily moved to new locations
- Can be installed with few parts
- Water is not sprayed into the air where it could be subject to wind drift and evaporation
- Pressure-compensating drip emitters provide a uniform flow rate

### *Disadvantages*

- Difficult to determine if emitters are clogged or tubing is kinked
- Visibility can lead to vandalism

## Micro-Sprays

### *Uses*

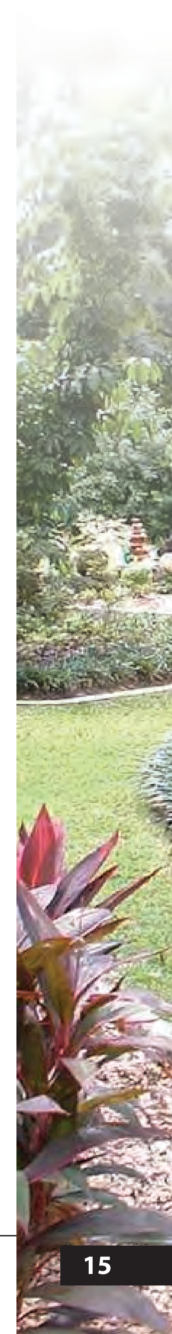
- Large groupings of plants with similar water needs
- Misting of new bedding plants and vegetables

### *Advantages*

- Emitters available in a large variety of spray patterns
- Easily moved to new locations
- Easy to tell if emitter is clogged
- Micro-sprays can be used for all soil types

### *Disadvantages*

- Many exposed parts can be easily damaged by wildlife or yard maintenance tools
- Visibility can lead to vandalism
- Water is sprayed into the air where it could be subject to wind drift and evaporation



## Bubblers

### *Uses*

- Establishment of large trees and plants
- Large planters

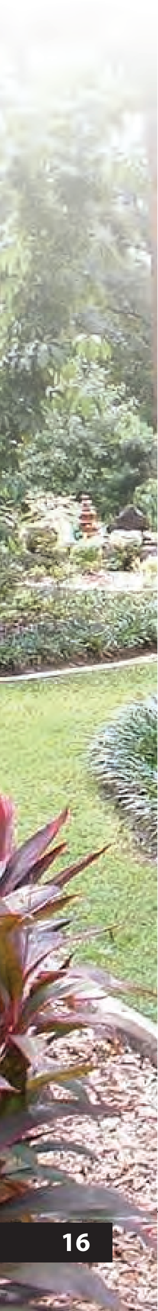
### *Advantages*

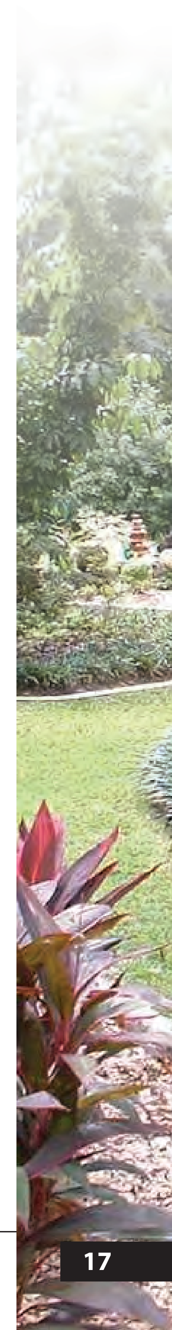
- Easy to turn on and off as needed
- Used to nurse plants, as during the plant establishment period
- Higher flow rates provide more water in a short amount of time
- Water is not sprayed into the air where it could be subject to wind drift and evaporation

### *Disadvantages*

- High flow rate can lead to ponding around plants if not monitored and properly adjusted
- In some cases, does NOT meet the definition of microirrigation due to high flow rates, so it may NOT be exempt from most watering restrictions

**Bubblers with flow rates greater than 30 gallons per hour are not considered microirrigation and are not exempt from water restrictions.**





# 3 From Planning to Installation — Things to Consider

This section is not intended to be used as the sole example of how to plan and install an irrigation system, but rather to provide readers with facts to consider when planning and installing microirrigation systems.

# 3.1 Evaluating the Landscape and Irrigation System

Most in-ground irrigation systems are divided into zones based on available water flow and type of vegetation being irrigated. Each **irrigation zone** should be designed to meet the water requirements of the plants within that zone. Developing a landscape and irrigation system **schematic** will aid in the design.

It is essential that in-line drip tubing, micro-sprays, drip emitters and bubblers be operated on separate valves from traditional spray and rotary sprinklers. For more detailed information about these components, see Section 2.1 (p. 10) "Common Components."

A microirrigation system design for a new landscape differs from the design for an existing landscape with an existing irrigation system. Therefore, the designer should answer the following when evaluating a site:

- Is this a new landscape?
- Is this an existing landscape?
- Is there an existing irrigation system?

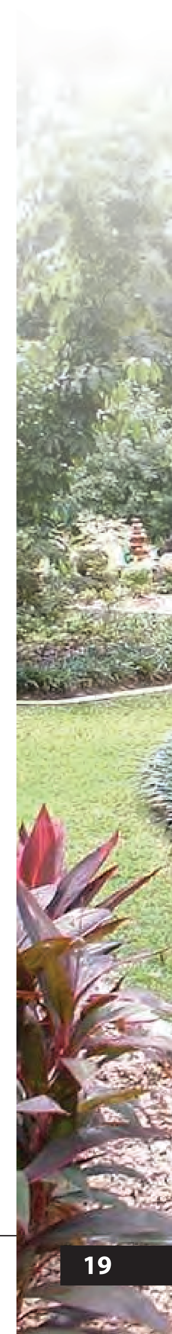
## New Landscape

In a new landscape, plants should be grouped together by their water needs into **hydrozones**, according to low, medium or high water requirements. Select the emitter devices to irrigate plants with similar water requirements.

## Existing Landscape

An existing landscape may have an area containing plants with different watering needs. If this is the case, consider regrouping plants into hydrozones. Each hydrozone should have a valve independent of other hydrozones. Emitter type, quantity and irrigation frequency will be determined by the plant with the highest daily water requirement, the **indicator plant**.

*Follow the flow chart on the next page to determine how a site evaluation should be performed.*



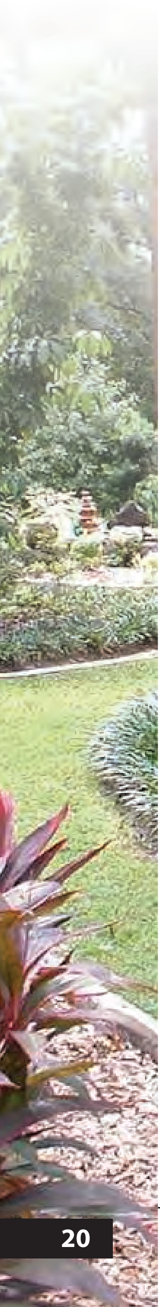
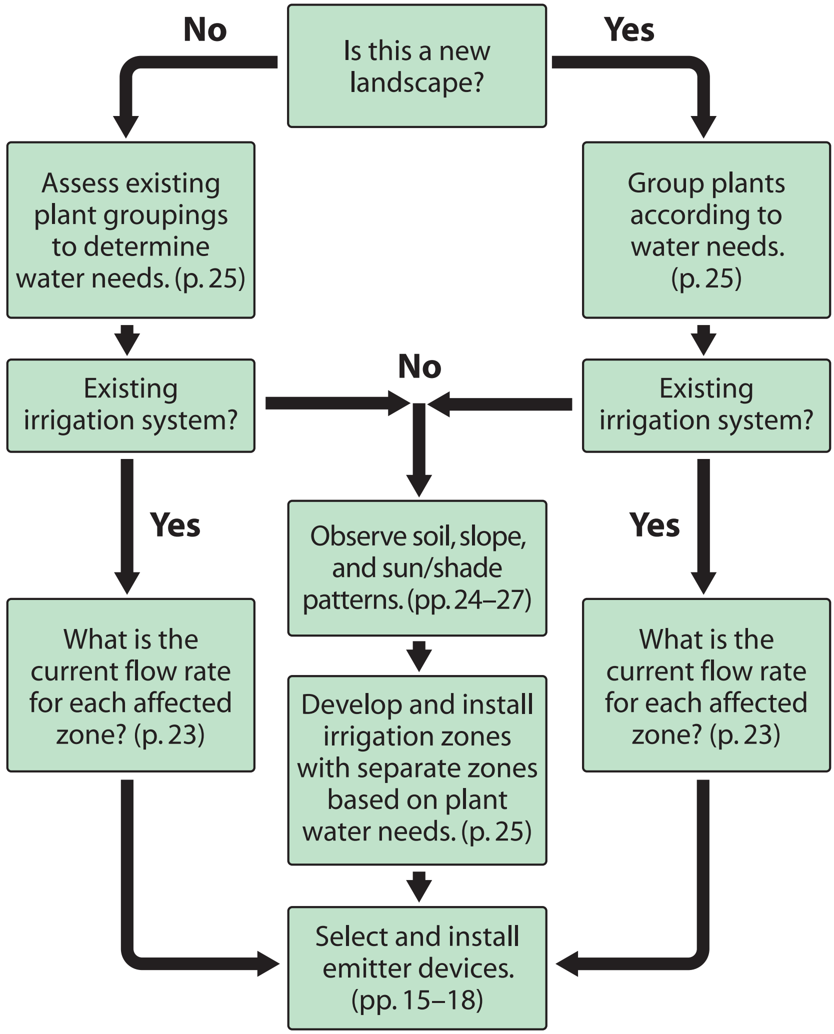


Figure 3.1 Evaluating the Landscape and Irrigation System Flow Chart



## Existing Irrigation System

If existing irrigation zones do not water landscape plants separately from lawn areas, major modifications or retrofitting systems may be required, such as installing valves to create new zones. If this type of work is necessary, contact a licensed irrigation contractor. The contractor will create new zones that will add valves, pressure regulators and filters.

When retrofitting an existing irrigation system, the design should take into account the total flow to the zone. The system should then be designed not to exceed that flow rating.

To the right is a common scenario, and possible solution, found when modifying traditional irrigation systems.

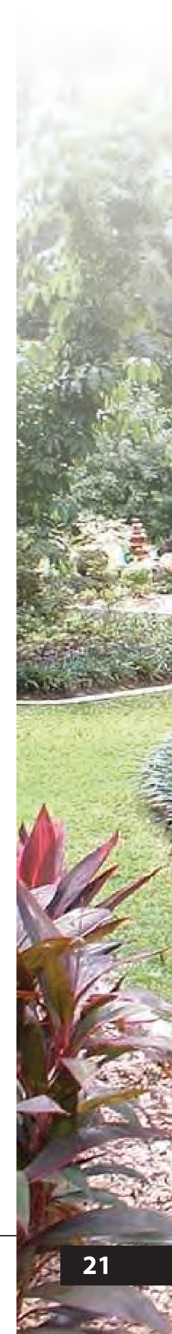
***Example 1: Retrofitting spray heads to micro-irrigation in a flower bed****

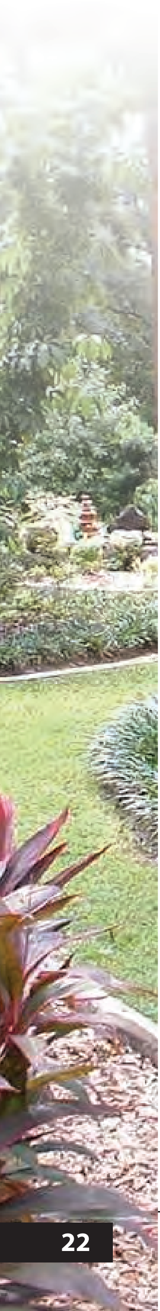
**Question:**
A landscape zone has three spray head sprinklers rated at 3.3 gallons per minute (gpm). The total flow rate to that zone is approximately 10 gpm, or 600 gallons per hour (gph). How many drip emitters are required to retrofit this zone?

**Answer:**
Since microirrigation devices are usually rated in gph, the options are:

1. Maximum of 600 1-gph emitters
2. 300 2-gph emitters
3. Maximum of 600 feet of in-line drip tubing rated at 1 gph/ft.

**You should retrofit an entire zone, not just one head within a zone.*





***Example 2:***
***Assume in-line drip tubing is used to solve the problem in Example 1***

**Question:**
What modifications are required before installing the drip tubing?

**Answer:**

1. Install microirrigation fittings to attach the system to existing sprinkler outlets
2. Add filters to each zone being retrofitted
3. Add in-line pressure regulator to reduce water pressure
4. Attach in-line drip or poly tubing to pressure regulator

## 3.2 Evaluating the Site Conditions and Plant Needs

### Soil

The type of soil present is one of the most significant factors in any irrigation system design. Systems should be designed to accommodate soil types with different water-retention or "water-holding" capacities. Figure 3.2 (p. 25) illustrates emitter considerations for different soil types.

#### *Sand soils*

- The most common soil in west-central Florida
- Contain large-sized particles and have low water-holding capacities
- Frequent irrigation and/or closer emitter spacing may be required than with clay or organic soils to adequately maintain soil moisture

***Florida-Friendly Landscaping™ Tip!***

Utilize drought-tolerant plants! If plant placement is done correctly, little or no supplemental irrigation will be necessary once plants are established.

- The wetting pattern has very little lateral movement

### *Loam soils*

- Contain medium-sized particles that hold the soil tighter together
- Better water-holding capacity than sandy soils

### *Clay soils*

- Contain small- to fine-sized particles
- High water-holding capacity

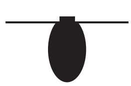
| Soil Type and Emitter Considerations | | |
|---|---|---|
| **Soil Type and Texture** | **Wetting Pattern** | **Drip Emitter Spacing** |
| Sand/Coarse |  | 12" x 12" |
| Loam/Medium |  | 18" x 18" |
| Clay/Fine |  | 24" x 24" |

Figure 3.2 Soil Type and Emitter Considerations

## Plant Grouping by Water Need

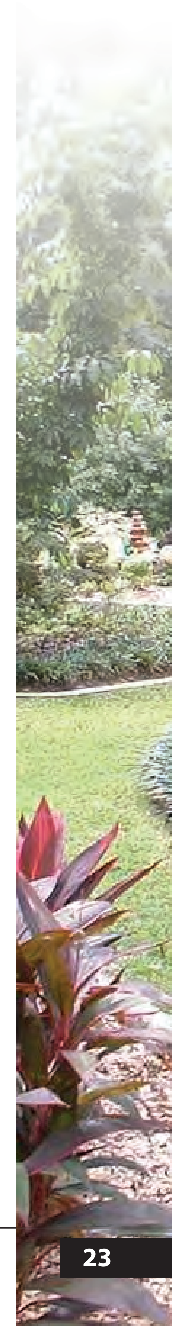
Group plants according to their water needs as follows:

- Oasis (high water requirements) plants may require regular watering
- Drought-tolerant (medium water requirements) plants may need supplemental irrigation during periods of extended **drought**
- Natural (low water requirements) plants will generally survive on rainfall alone once established

## Potted Plants

Irrigation of potted plants and hanging baskets poses several challenges:

- Water has to be spread evenly throughout the container
- Plants in containers may require more frequent watering because of their restricted root systems
- Potting soil may dry out faster than soil in landscape beds
- Watering duration must be monitored to prevent excessive watering, root rot or inadequate watering



## Plant Grouping by Sun and Shade Patterns

Plants with similar water needs may require less frequent irrigation when planted in shady areas versus those planted in sunny areas. However, make sure the plant is shade tolerant before placing in a shady spot.

## Plant Spacing Considerations

The size of a plant is an indication of the plant's root system. Roots generally extend one to three times beyond a shrub or tree canopy. Since the roots of most ornamental plants are quite shallow, they utilize water stored in the top 6 to 12 inches of soil.

Dense plantings usually consist of shrubs placed close together or plants that completely cover the ground, requiring emitters that supply a precise amount of water across the entire area. Micro-sprays may be the best emitter type for this scenario.

As plants mature, **foliage** can crowd emitters and roots can spread out far beyond the plant canopy. Therefore, irrigation systems should be designed with the flexibility to meet the anticipated plant growth. See picture below.

**Flexible Dripline Placement**

***Florida-Friendly Landscaping™ Tip!***

Check with the horticulture department of your local county Extension Service for information on the water requirements of plants. See page 59 for contact information.

## Slopes and Runoff Potential

Controlled coverage and correct emitter placement are important on sloped areas since water can flow downhill and out of the root zone, carrying soil, nutrients and **mulch** with it. To avoid these problems:

- Install distribution tubing perpendicular to the slope and place emitters above plants. In this manner, the wetting pattern remains within the root zone and erosion is minimized. *See Figure 3.3.*
- Tubing/ emitters should be spaced wider at the bottom of the slope, where water tends to collect.

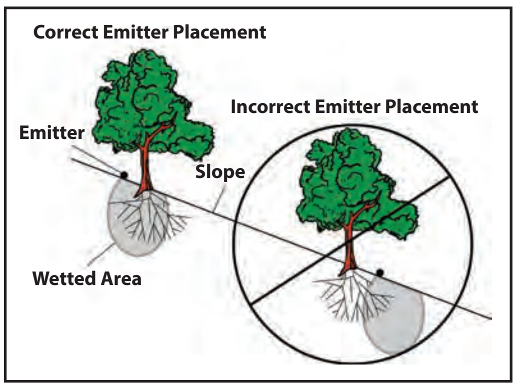



Figure 3.3 Slope Installation

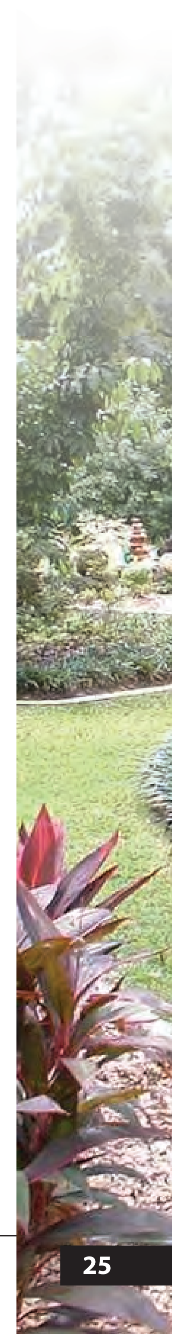
Runoff potential depends on type of terrain (sloped vs. non-sloped), soil type and plant cover. **Erosion** can be decreased by planting ground covers that hold the soil or by terracing sloped areas.

## Buildings and Damage Potential

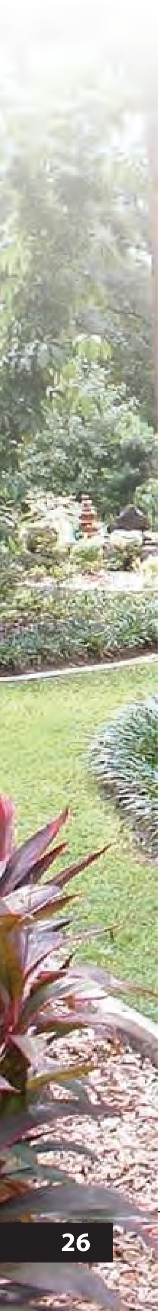
Micro-sprays should be directed to spray away from buildings and exterior walls to avoid water spots on windows and walls. Install all components at least 12 inches from building foundations.

***Florida-Friendly Landscaping™ Tip!***

Planting drought-tolerant plants together in one irrigation zone will allow that group of plants to be watered only as needed.



## 3.3 Water



Determine which of the following water source(s) is being used or will be used:

- ***Drinking water***

  Water that is suitable for consumption and that meets or exceeds all applicable federal, state and local requirements concerning safety.

- ***Reclaimed water***

  If the irrigation system uses reclaimed water, valve boxes and any exposed pipe must be colored purple for identification. A thorough on-site cross connection and backflow prevention inspection must be performed by the reclaimed water provider.

- ***Well water with a pressure tank***

  This type of well system provides water at a pressure similar to the municipal water supply. Water from the pressure tank is provided "on demand" if the irrigation flow is less than the pump discharge. If irrigation flow is equal to the pump discharge, the pump will operate according to its operational specifications (continuously). (NOTE: If creating new hydrozones, the flow rates to those zones should be compatible with the existing pump.)

- ***Well water without a pressure tank***

  These types of systems are sensitive to changes in flow rates of any zone. Each zone should have the same flow rate to avoid pump cycling, which could result in pump damage.

- ***Surface water***

  This water, supplied via pump by withdrawal from lakes, rivers, ponds and canals, varies in quality. Depending on the type of sprinklers and/ or emitters used, filtration or water treatment may be necessary. This type of system is sensitive to change in flow rates.

**Water Pressure** is the force applied by water over a given area and is measured in pounds (force) per square inch (area), or psi. Operating water pressure for microirrigation is most efficient between 15–30 psi. It is likely that pressure regulation will be necessary, since initial water pressure is typically higher than that required by microirrigation systems. Without pressure regulation, high water pressure can damage the irrigation system and break connections. Pressure-regulating devices must be sized for the system's flow rate. Water pressure readings can be obtained by connecting a pressure gauge to the water source.

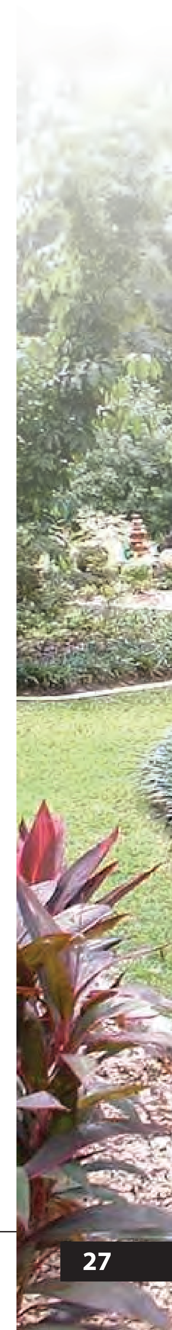
**Water Quality** can create problems in a microirrigation system. Filtration and, in some cases, water treatment may be necessary, depending on the water source. Water quality problems can be classified as physical, biological or chemical. For more information, see Section 5.3 (p. 49) "Water Sources and Emitter Clogging."

**Filtration** is required for microirrigation systems to prevent emitter clogging.

**Backflow Prevention Devices** prevent contaminated water from entering the drinking water supply. All irrigation systems using municipally supplied water or fertilizer injection systems are required to have backflow prevention devices.

Pressure Tank

Water Pressure Meter



## 3.4 Installation Considerations

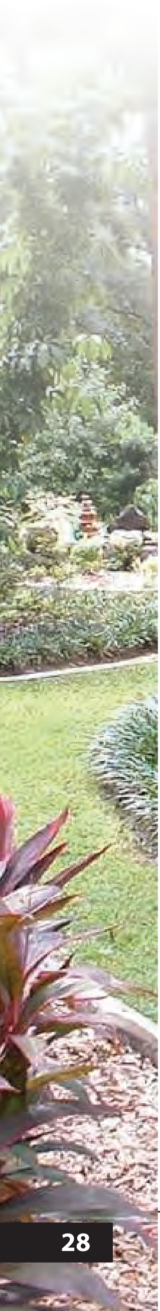
Once an irrigation system schematic is created and the necessary equipment is obtained, the system can be installed. By following a few simple design and installation guidelines, many operational problems can be avoided.


## Design and Installation Guidelines

- Do not run ½-inch distribution poly tubing more than 250 feet
- Do not run ¼-inch spaghetti tubing more than 5 feet
- Do not run in-line drip tubing more than 200 feet
- Use buried PVC pipe or poly tubing to deliver water closer to the irrigated area
- Place emitters so they are evenly spaced around plants; for example, emitter should be placed halfway between a tree's trunk and the canopy edge
- Install micro-sprays to provide head-to-head coverage
- For large trees, potted plants and hanging baskets, additional rows and/or emitters may be necessary to meet the plants' water needs
- Maintain plant health by moving emitters away from plants as they mature to encourage proper root development

***Florida-Friendly Landscaping™ Tip!***

CAUTION! When microirrigation equipment is not properly used or scheduled, overwatering can result! Light, frequent watering can also encourage disease and create shallow-root systems, which reduces drought resistance.



## Types of Microirrigation Installations

There are three basic types of microirrigation installations: hose-end connection, traditional irrigation system retrofit and new system installation. Necessary component checklists are identified below for each and should be used.

### *Hose-End Connection*

❒ Backflow prevention device

❒ Filtration

❒ Pressure reducer

❒ If using ½-inch poly tubing, does maximum length meet design and installation guidelines?

❒ If using ¼-inch spaghetti tubing, does maximum length meet design and installation guidelines?

❒ Ability to flush out lines

### *Traditional Irrigation System Retrofit*

❒ Filtration — needs to be added if it does not exist

❒ Pressure reducer(s)

❒ If using ½-inch poly tubing, does maximum length meet design and installation guidelines?

❒ If using ¼-inch spaghetti tubing, does maximum length meet design and installation guidelines?

❒ Ability to flush out lines

### *New System Installation*

❒ Valves — correct size for flow or pressure

❒ Filtration device(s)

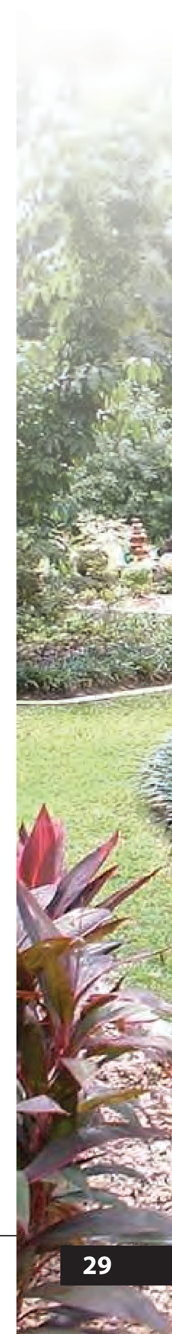
❒ Pressure reducer(s)

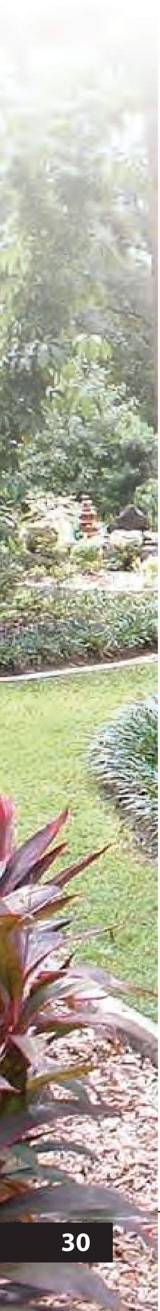
❒ If using ½-inch poly tubing, does maximum length meet design and installation guidelines?

❒ If using ¼-inch spaghetti tubing, does maximum length meet design and installation guidelines?

❒ Emitter types installed meet intended need

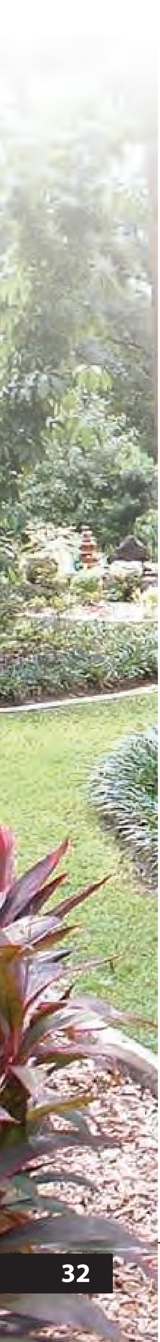
❒ Ability to flush out lines





# 4 Operation

Overwatering is a common cause of many lawn and landscape problems. Proper scheduling, operation and periodic inspection of a microirrigation system is necessary to prevent excessive watering.



## 4.1 Irrigation Controller (Timer) Operation

Most automatic irrigation controllers have operating instructions attached to the interior panel of the controller cover. If the label or instruction manual is missing, contact the manufacturer's web site customer service department.

It is best to use a separate irrigation schedule, independent of spray and rotor zones, when irrigating with microirrigation. This allows microirrigation zones to run independently from the rest of the irrigation system. In an established landscape, adjust the controller seasonally to irrigate based on the plants' water requirements.

## 4.2 Landscape Irrigation Considerations

### Plant Maturity

Irrigation schedules should be designed with the flexibility to meet water needs as plants mature. During the establishment period (the period between plant installation and the time when the root system is substantial enough to survive without supplemental irrigation) it is necessary to provide a regular watering schedule. When watering newly installed plants, irrigate frequently for short durations to promote root development. *For more detailed information, see Table 4.1 (p. 35) "Watering Guidelines."*

Over time, gradually decrease watering frequency while increasing the duration to promote a deeper, more drought-tolerant root system. Once the plant has developed a substantial root system, watering can be reduced to an "as needed" basis.

***Florida-Friendly Landscaping™ Tip!***

Watering to below the root zone encourages plants to develop deeper, more extensive root systems that are able to draw moisture from the soil at times when there is no rain.

### Weather Variations

Reduce irrigation frequency during periods of slow plant growth (typically November through February) or frequent rain events (typically June through September).

### Soil Type

Plants grown in sandy soils may require more frequent watering and/or closer emitter spacing than those in loam or clay soils. For more detailed information, see Figure 3.2 (p. 23) "Soil Type and Emitter Considerations."

### Sun and Shade Patterns

Due to lower **evapotranspiration** rates, plants in shady areas may require less frequent irrigation than those planted in sunny areas of the landscape. If installing a new irrigation system or zone, or making modifications, provide separate zones for plant beds in sunny and shady areas. Sometimes an existing system will irrigate sun and shade areas together, and only minor modifications will be needed. Such modifications include increasing the flow rate or number of emitters in the sun and/or decreasing the flow rate or turning off emitters in the shade.

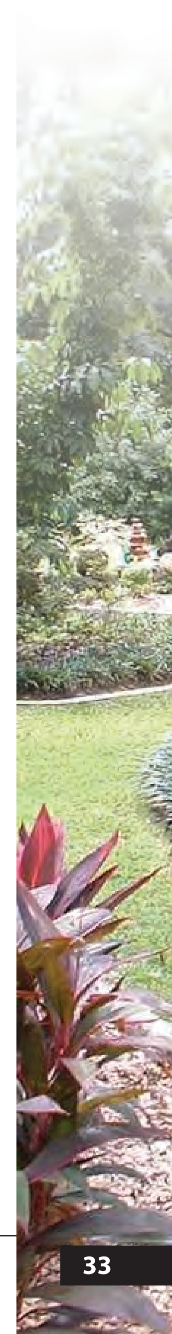
### Plant Type

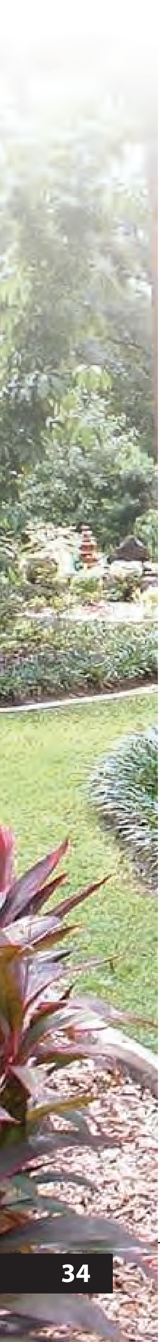
Plants are grouped into one of three water-use categories or hydrozones: oasis, drought-tolerant or natural. When watering plants, irrigate according to specific hydrozone requirements. For more detailed information about plant categories, refer to p. 23, "Plant Grouping by Water Need."

## 4.3 Scheduling Considerations

Generally, microirrigation has been less restricted than the day-of-week restrictions. This is a benefit, as plants may be watered as needed, not on a set schedule. However, watering restrictions may limit the time of day irrigation is allowed. Contact your local water utility or municipal government for current restriction details. Program the controller/timer to irrigate plants "as needed" with three variables in mind:

- Watering times
- Duration
- Frequency





## Watering Times

If using micro-sprays, it is best to water during cooler, early morning hours to minimize wind drift or evaporation from the sun. Drippers that emit water below mulch are not affected by evaporation or wind, as long as mulch is of adequate depth (2 to 3 inches).

## Duration

Controllers should be set to run systems to apply the required amount of water in each zone. Central Florida soils are typically sandy and hold about one inch of water in the top 12 inches of soil. Because most roots are in the top six to eight inches of the soil profile, ¾-inch application of water will wet the soil in the plant root zone and encourage deep rooting. The goal is to replace soil moisture as it becomes depleted. Although plants may be grouped by similar water requirements, most hydrozones have unique characteristics and watering time for each zone should be determined separately.

## Frequency

Landscapes generally should be irrigated as needed. A visual plant check (wilting leaves) combined with a soil check (feel for moisture below the soil surface) is an effective way to determine if a plant needs water. Many plants may require ¾ to 1 inch of water per week during the growing season. An irrigation system operating schedule should be adjusted according to the type of microirrigation, hydrozone groupings and the conditions *listed on p. 32 "Landscape Irrigation Considerations."*

*For more information on watering applications see Appendix on p. 57.*

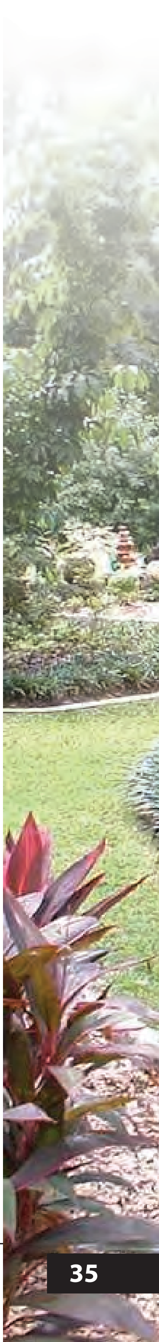
### *Florida-Friendly Landscaping™ Tip!*

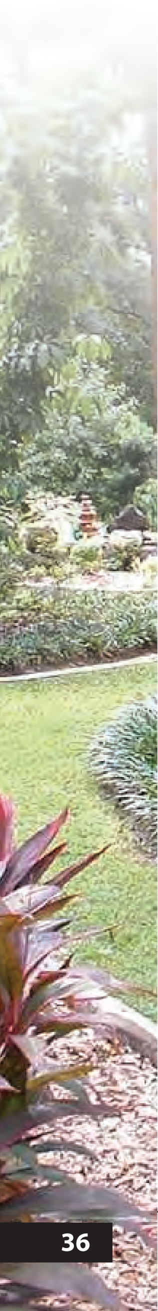
If manually operated irrigation system equipment is left unattended, a timer should be used to alert someone when to stop watering. An example would be a kitchen timer or a battery operated microirrigation timer.

Table 4.1 Watering Guidelines for Trees and Shrubs During Establishment Periods

| Type of Plant | Establishment Period | Watering Schedule[A] | Recommended Amount of Water[B] |
|---|---|---|---|
| Trees with less than 2" trunk diameter | 3 to 6 months | 1. Daily for 2 weeks<br>2. Every other day for 2 months<br>3. Then weekly until established | 2 to 3 gallons per inch of trunk diameter |
| Trees with 2" to 4" trunk diameter | 6 to 12 months | 1. Daily for 1 month<br>2. Every other day for 3 months<br>3. Then weekly until established | 2 to 3 gallons per inch of trunk diameter |
| Trees with over 4" trunk diameter | 12 or more months | 1. Daily for 6 weeks<br>2. Every other day for 2 months<br>3. Then weekly until established | 2 to 3 gallons per inch of trunk diameter |
| Shrubs in 1-gallon containers | 3 to 6 months | 1. Every day for first few weeks after planting<br>2. Gradually decrease to every other day, to every third day until established | 1 quart |
| Shrubs in 3-gallon containers | 6 to 12 months | 1. Every day for first few weeks after planting<br>2. Gradually decrease to every other day, to every third day until established | 2 quarts |
| Shrubs in 7-gallon containers or larger | 1 to 2 years | 1. Every day for first few weeks after planting<br>2. Gradually decrease to every other day, to every third day until established | 1 gallon |

Notes:
A Frequency should be reduced when plants are installed during the cooler months or during periods of frequent rain or when watering restrictions change.
B Do not water if the root ball feels moist to the touch.
C During extended drought conditions, additional irrigation is required.





Overwatering

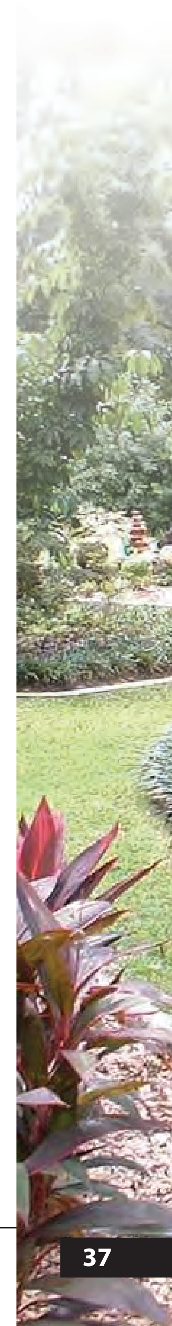
Underwatering

## Signs of Overwatering:

- Leaves may turn yellow or light green
- Leaves may droop (wilt)
- Roots will be wet/mushy and dark brown to black in color
- Soil around roots feels moist to the touch
- Unusually high monthly water bill (only if water is volumetrically metered and billed)

## Signs of Underwatering:

- Leaves turn pale or lighter green
- Leaves may droop (wilt)
- Leaves may turn brown from the edges and drop off stems
- Soil around roots feels dry to the touch



# 5 Maintenance and Troubleshooting

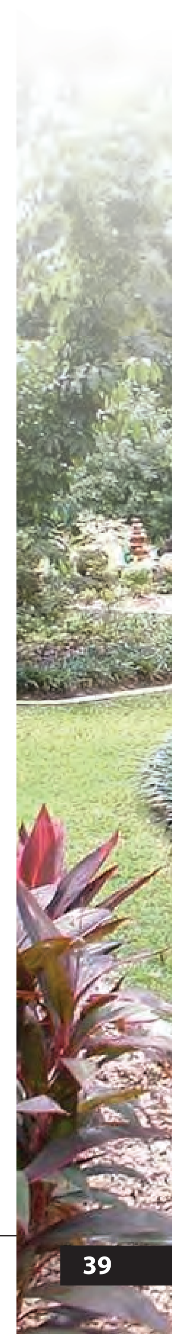
Regular inspections and maintenance are essential for identifying and preventing costly microirrigation system problems. Microirrigation equipment is easy to repair since components are placed on or near the soil surface. Although the most common problem encountered is clogging, an irrigation system may also be damaged by garden tools, animals, overexposure to sunlight and interference from growing plants.

## 5.1 Maintenance Guidelines

To properly maintain the system:

- Periodically inspect plants for signs of over- or underwatering, such as wilting and/or changes in leaf color. If necessary, adjust the flow to each plant. *See examples of over- and underwatering on p. 36.*
- Check soil wetting patterns around individual plants to ensure that at least half of the root zone area is covered. Whole root zone coverage is preferable.
- Inspect and clean filters and emitters on a regular basis. Even with the best filters, dirt and debris will accumulate in the irrigation system. Flush the system at least every two months to avoid clogging emitters.
- As plants grow, inspect emitters and move them away from the original planting area.
- Reset the irrigation controller seasonally to adjust to changes in plant water needs.
- When replacing parts, use only parts specified by the equipment manufacturer.

*Specifics on maintenance are listed in Tables 5.1 (p. 40) and 5.2 (p. 41).*



***Florida-Friendly Landscaping™ Tip!***

Get your finger wet! Some plants, such as impatiens and vegetables, will naturally wilt in the afternoon, only to perk back up in the evening as the sun goes down. Checking the soil moisture content around the plant's root system will indicate if watering is actually needed. Only water if wilt is still observed the next morning.

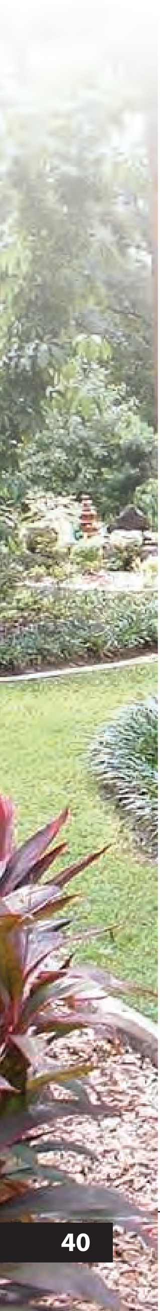
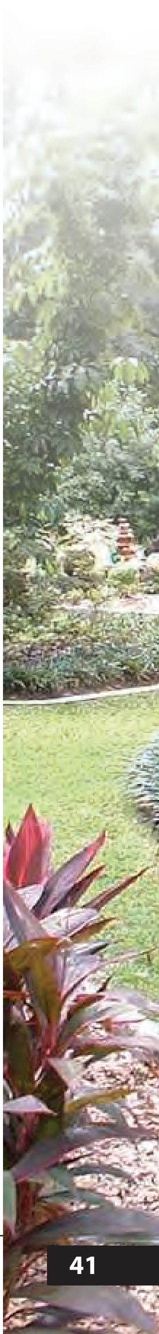


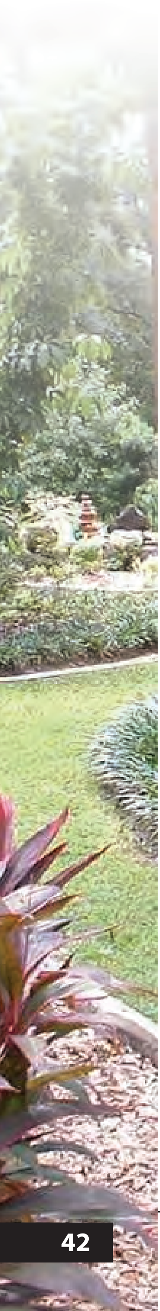
Table 5.1 Microirrigation System Checklist: After Initial Installation

| Frequency | Inspect | Action required |
|---|---|---|
| Weekly | All filters | **Clean** all filters. |
| | Plants for signs of under-watering | **Check** for clogged emitters or a kink in the distribution and spaghetti tubing. If plants still show signs of underwatering, **increase** number and size of emitters one at a time to identify any potential pressure problem. |
| | Plants for signs of over-watering | **Decrease** irrigation time if plants show signs of overwatering. **Decrease** number and size of emitters one at a time to minimize/eliminate any pressure problems. |
| | Emitters for proper operation | **Look** for and clean clogged and/or broken emitters.<br>**Run** the system and listen for running water (indicating a break in the lines) if needed. |
| | Soil or mulch | **Look** for unusual holes and/or white sand, which may indicate broken lines or missing emitters.<br>**Flush** lines and look for signs of debris in water, which may indicate breaks in the lines or failed filters. |

Table 5.2 Microirrigation System Checklist: Regular Maintenance Schedule

| Frequency | Action required |
|---|---|
| Monthly | **Inspect** and clean filters.<br><br>**Inspect** emitters for clogging, proper pressure and coverage; clean or replace emitters as required. |
| Every 2 months | **Flush** all lines by opening flush valve or unbending the kinked end of distribution line until water runs clear — this should take only a few seconds.<br><br>**Examine** water for signs of debris or suspended matter.<br><br>**Reset** irrigation controller with each change of season. |
| Twice per year | **Ensure** all flush valves and valve boxes are visible.<br><br>**Replace** battery in automatic timer.<br><br>**Move** emitters away from base of growing plants as needed.<br><br>**Clear** valve boxes of dirt or debris. |
| Once per year | **Test** backflow prevention device. |





## 5.2 Troubleshooting

The following information is provided to assist in identifying problems and possible solutions. Component operation manuals should be referenced for more detailed information. Most manufacturers have manuals available on the Internet. If you are unable to troubleshoot any problems identified in Table 5.3 (p. 43), contact a licensed irrigation contractor. A properly designed microirrigation system should include preventative measures to avoid emitter clogging. Specific recommendations vary by individual systems; however, each system should include flush valves and a method of filtering water.

## 5.3 Water Sources and Emitter Clogging

The cause of emitter clogging varies with water source. There are physical, biological and chemical problems associated with different water sources.

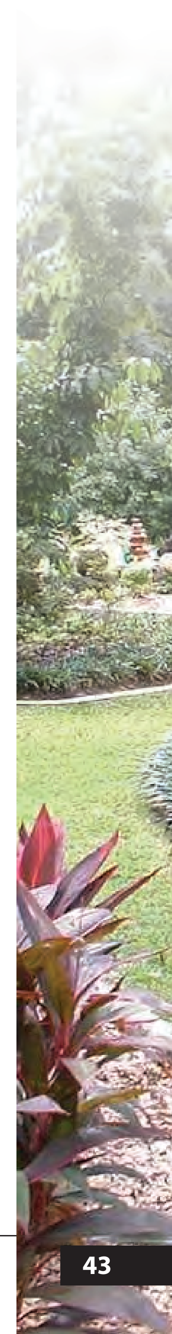
- **Physical**
  Sand, pebbles and suspended debris, most often found in surface, well or reclaimed water, can be too large to pass through tiny openings of emitters.
- **Biological**
  Algal and bacterial growth, as well as small organisms associated with surface water, are often small enough to pass through filters in an irrigation system.
- **Chemical**
  Florida's water may contain high levels of calcium, magnesium, iron or manganese, which may cause scaling and clogging. Scaling occurs when minerals precipitate, creating particles large enough to block the flow of water through emitters.

***Florida-Friendly Landscaping™ Tip!***

Look and listen! Casual observation can assist in preventing major problems in your landscape and irrigation system. Walk your yard frequently to become familiar with it during all seasons and to be able to easily and quickly identify anything that seems abnormal.

Table 5.3 General System Troubleshooting

| Problem | Potential Cause | Solution |
|---|---|---|
| Plants show water-related stress | Clogged emitter | **Clean**/replace emitter. |
| | Clogged filter | **Flush** filter. |
| | Timer/controller not operating | **Check** power source and timer switch. |
| | Run times too long/short | **Adjust** run time. |
| | Run frequency is excessive/not adequate | **Adjust** run frequency. |
| | Valve not operating properly (See automatic valve section below) | **Replace** valve or **consult** irrigation contractor. |
| | Plants not grouped by hydrozone | **Regroup** plants according to water needs.<br>**Adjust/add** micro-irrigation lines or emitters (see Section 3, p. 31). |
| Automatic valve does not operate properly | Water not turned on | **Turn** water source on. |
| | Rain sensor interrupting valve operation | **Test** rain sensor for proper operation.<br>**Adjust** rain sensor shutoff quantity to permit valve operation. |
| | Incorrect valve size | **Replace** with correct size valve for proper flow. |
| | Valve diaphragm not closing properly | **Check** diaphragm for sand and/or other debris; clean or replace diaphragm. |
| | Faulty solenoid or damaged wire | **Check** and repair wiring or replace solenoid. |



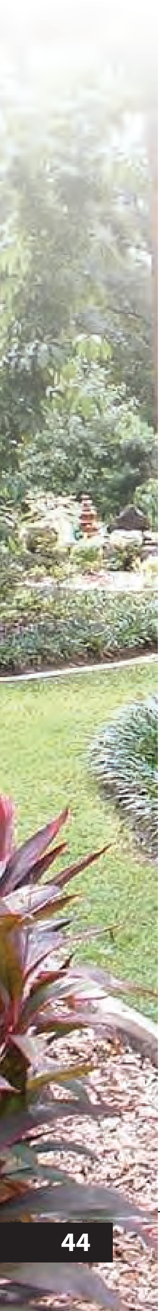
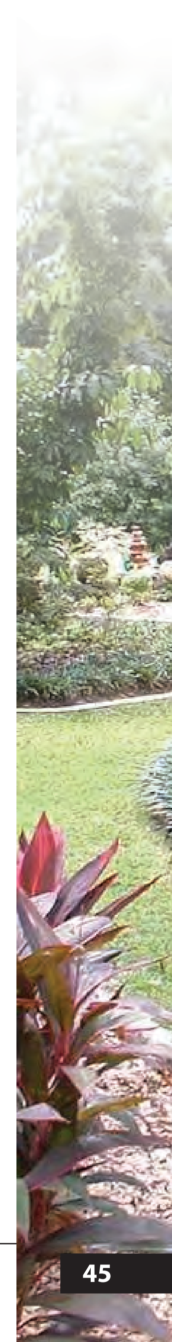


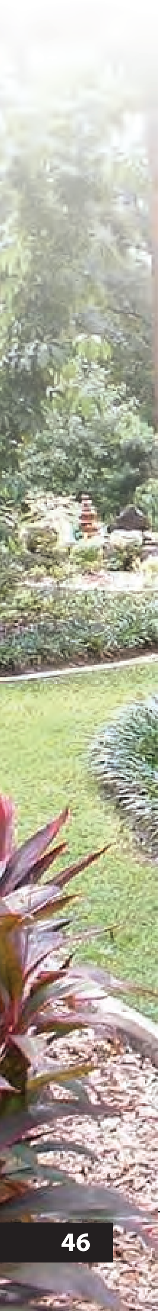
Table 5.3 General System Troubleshooting (continued)

| Problem | Potential Cause | Solution |
| --- | --- | --- |
| No emitter flow or uneven spray pattern | Water is not turned on | **Turn** water source on. |
| | Emitter clogged or faulty | **Flush**, repair or replace emitter. |
| | Filter clogged | **Clean** or replace filter. |
| | Pressure too high or too low | **Ensure** pressure regulator is installed.<br>**Adjust** flow control on valve. |
| | Supply line could be severed or kinked | **Remove** kink or repair line. |
| Emitter(s) loose or detached from tubing | Emitter is not installed properly | **Check** and reinstall or replace emitter. |
| | Pressure too high | **Ensure** pressure regulator is installed. |
| | Faulty or worn punch hole in tubing | **Replace** section of tubing, or plug hole with **goof plug** and place emitter elsewhere on tubing. |
| | Emitter retaining collar (located where it connects to the tubing) loose or missing | **Check** tip of hole puncher for defects.<br>**Adjust** or repair retaining collar. |

Table 5.3 General System Troubleshooting (continued)

| Problem | Potential Cause | Solution |
|---|---|---|
| Drip tubing detached at the fittings | Fittings are improperly installed | **Replace** fittings or reinstall existing fittings. |
| | Size of fittings and tubing are incompatible | **Check** and replace with correct size. |
| | Pressure is too high or regulator is not installed | **Install** pressure regulator. **Check** pressure regulator for flow compatibility. |
| Excessive well pump cycling | Pump flow exceeds micro-irrigation system demand | **Install** pressure regulator. **Check** pressure regulator for flow compatibility. Increase micro-irrigation zone flow to match pump flow (add emitters or increase flow rate). |
| | Absence of pressure tank | **Install** pressure tank of appropriate size. |
| | Existing pressure tank needs maintenance | **Check** pressure tank. |

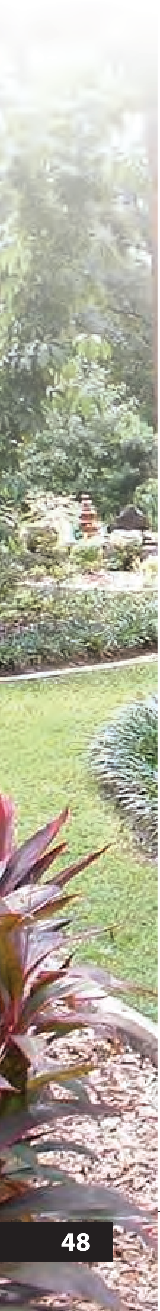




# 6 Considerations for Hiring an Irrigation Contractor

If the assistance of an irrigation contractor is required, it is essential to determine if he/she is qualified to design, install and maintain an irrigation system. Speak with several contractors before making a decision. A professional contractor should provide a written bid, including each work effort in detail. A more detailed bid usually reflects contractor professionalism. It is important to accept the best bid, even if it is not the least expensive.

When determining which contractor to use, the following questions could help ensure that the contractor is reputable and capable of providing a quality system.



## 6.1 Bids or Proposals

A bid or proposal is a guarantee of professional work and a statement specifying mutually agreed upon standards. Regardless of the estimated cost, insist on a written bid or proposal for your protection. After the bid or proposal is signed, any changes you and the contractor agree to make in work or materials to be used must be in writing. This written "change order" must also include any additions or reductions in the total job price. The following is a list of basic elements that should be included in most irrigation bids or proposals:

- Specific costs of materials to be installed.
- A specified start date and an estimated completion date.
- A statement regarding payment arrangements such as down payment, progress payment and balance due.
- The name, street address and telephone number of the contractor.
- A complete description of work to be performed and materials to be used (including quantities and brands of irrigation equipment).
- Guarantees of work and materials.
- A statement that the contractor will do any necessary cleanup and removal of debris daily and after job completion.
- A "Notice to Owner" explaining the state's mechanic's lien laws and ways to protect you and your property.
- A "Notice of Cancellation" stating that you have three days following contract signature to cancel.
- A statement requiring the contractor to provide proper lien releases for suppliers.
- Validation of any required license and certificates of insurance, not just copies.
- Identification of party responsible for obtaining appropriate permits.

## 6.2 Before Work Begins

### Licensing and Permitting

- Does the contractor have a current local irrigation contractor license if required by your local government? (Ask to see the license to check its validity.)
- Will the contractor provide and secure all necessary permits required by the appropriate municipality? What are the necessary permits?

### Insurance

- Will the contractor provide a copy of the company's Certificate of Insurance for Liability and Workers' Compensation?

### Experience, Training and Affiliations

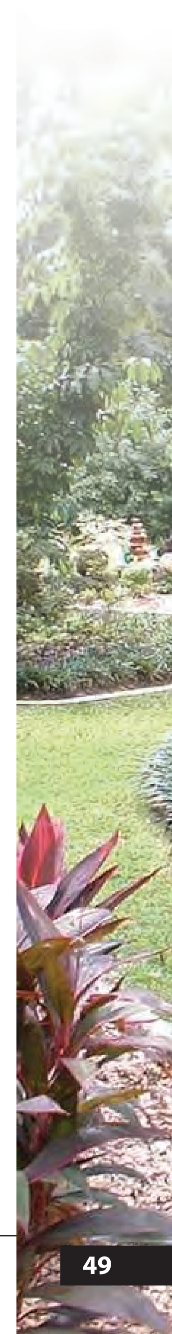
- Is the contractor a current member of the Florida Irrigation Society, Irrigation Association, EPA WaterSense™ Progrm, and/or other reputable irrigation organization?
- How much experience does the contractor have in designing, installing and maintaining microirrigation systems?
- What type of training and certification has he/she received? Is microirrigation one of them? From which professional organization was the certification obtained?

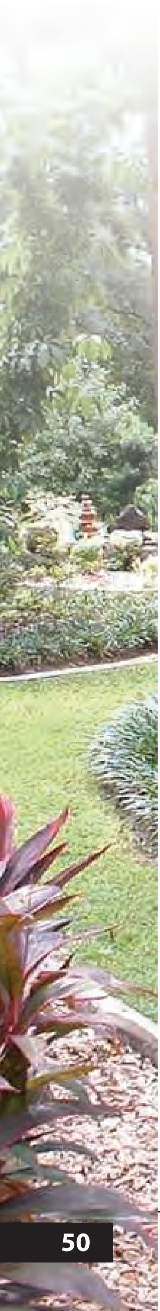
### Design and Installation Considerations

- Will the irrigation system include a backflow prevention device and filters?
- Will the contractor be installing a rain sensor device on the irrigation timer?
- Does the existing irrigation timer have multiple programming capabilities? If not, will the contractor install one?

### Business Practices

- How long is the warranty for parts and labor?
- Will the contractor revisit the site free of charge to make necessary adjustments within the first month if excessively wet or dry areas appear?
- Upon completion of the installation, will the contractor submit a schematic of the





irrigation design bearing the contractor's license number and contact information?

- Will the contractor clean up the job site at the end of the work day and/or when the job is complete?
- What is the specific start date and estimated completion date?
- Will a subcontractor be performing the work? Will the contractor perform a prior walk-through of the job with that person/company?
- Will the contractor inspect the work performed by the subcontractor during and after the job?

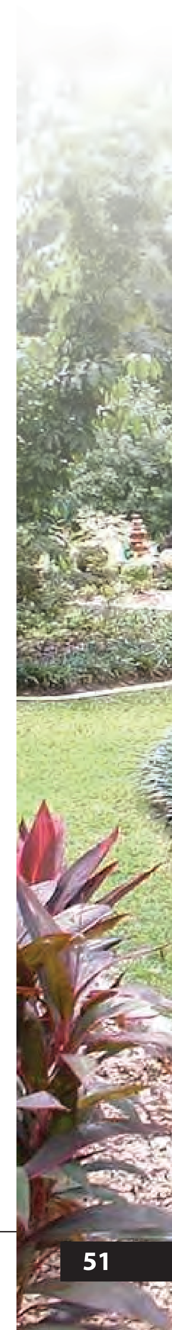
## 6.3 After Work Is Completed and Before Payment

The following questions should be answered during the selection process and completed after installation.

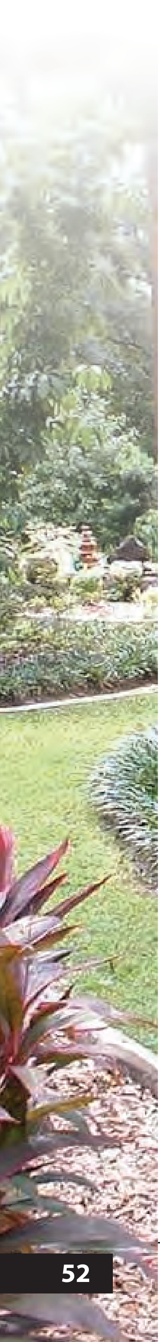
- Following job completion, will the contractor demonstrate to the homeowner how to operate the system and provide instructions in the operation of the irrigation system in both the automatic and manual modes?
- Will the contractor demonstrate that each component in the irrigation system is completely operational?
- Will the contractor provide system care instructions/maintenance schedules?
- Will the contractor provide the operation manual for the controller and other mechanical/electronic components?

***Florida-Friendly Landscaping™ Tip!***

With a multiple-programmable time clock, you will have the flexibility of varying the frequency and day of the week for watering various areas (zones) of your landscape. Remember to follow all local watering restrictions.



# Other Resources



**City of St. Petersburg Water Resources Department**
(727) 893-7261
www.stpete.org/WaterConservation

**City of Tampa Water Department**
(813) 274-8121
www.TampaGov.net/water

**Florida Irrigation Society**
(813) 839-4601
www.fisstate.org

**Hillsborough County Public Utilities**
(813) 272-5977
www.hillsboroughcounty.org/water

**Pasco County Utilities**
(727) 847-2411
or (352) 521-2411, ext. 8145
or (813) 996-2411
www.pascocountyfl.net

**Pinellas County Utilities**
(727) 464-3896
www.pinellascounty.org

**Southwest Florida Water Management District**
1-800-423-1476 (In Florida only)
www.WaterMatters.org

**Sunshine** *(call 48 hours before digging)*
811 or www.sunshine811.com

**Tampa Bay Water**
(727) 796-2355
www.tampabaywater.org

**For classes on Florida-Friendly Landscaping™, including microirrigation systems, contact your county's UF/IFAS Extension Service.**

**Hernando County**
(352) 754-4433
extension.hernandocounty.us

**Hillsborough County**
(813) 744-5519
hillsborough.ifas.ufl.edu

**Manatee County**
(941) 722-4524
manatee.ifas.ufl.edu

**Pasco County**
(352) 518-0156
pasco.ifas.ufl.edu

**Pinellas County**
(727) 582-2100
pinellas.ifas.ufl.edu

**Sarasota County**
(941) 861-9900
sarasota.ifas.ufl.edu

# Useful Links

**EPA's Watersense™**
www.epa.gov/watersense

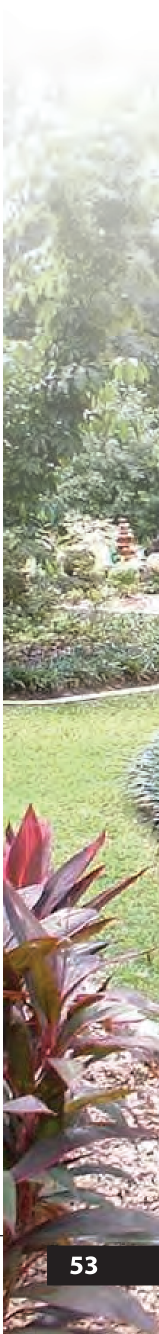
**Electronic Data and Information Source/Institute of Food and Agricultural Science – EDIS/IFAS**
edis.ifas.ufl.edu

**Florida Irrigation Society – FIS**
www.fisstate.org

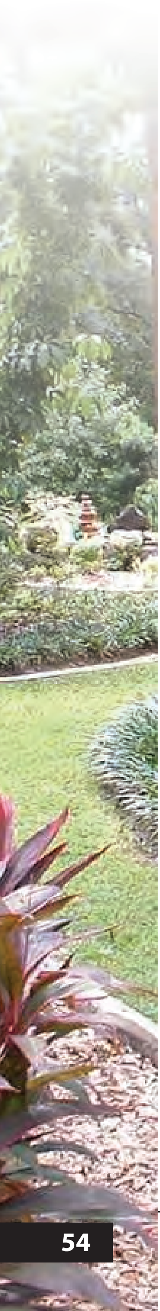
**Florida-Friendly Landscaping™ – FFL**
fyn.ifas.ufl.edu

**Tampa Bay Water PDF format of guide**
www.tampabaywater.org/documents/conservation/microirrigationMODIFIED.pdf

**Irrigation Association**
www.irrigation.org



# Glossary



**Algae** – tiny, simple, rootless plants; algae can accumulate inside microirrigation components and cause clogging.

**Application rate** – equivalent rainfall or irrigation rate, expressed in inches of water depth per hour.

**Backflow prevention device** – safety device used to prevent contamination of the drinking water supply due to water backflow from an irrigation system.

**Bubbler** – type of emitter used to provide large amounts of water to newly installed trees and large shrubs; usually NOT considered a microirrigation emitter due to flow rates in excess of 30 gph.

**Distribution tubing** – microirrigation system component used to convey water from its supply connection to the plant area; provides a connection point for emitters; distribution tubing is usually flexible polyethylene (poly) tubing, but polyvinyl chloride (PVC) pipe can be used.

**Drip emitter** – type of microirrigation device that slowly applies droplets of water immediately under the emitter.

**Drought** – conditions where soil moisture is insufficient to meet plant needs.

**Emitter** – microirrigation system component that delivers water directly to plant area; emitter components include in-line drip tubing, drip emitters, micro-sprays and bubblers.

**Erosion** – process of water or wind relocating soil, mulch and/or nutrients away from the plant area.

**Evapotranspiration (ET)** – combined process of water loss by surface evaporation and water transfer to the air by plant tissues.

**Florida-Friendly Landscaping™** – design principles and maintenance practices that promote and conserve Florida's natural resources.

# Glossary

**Flow rate** – amount of water passing through an irrigation component or system in a unit of time; normally measured in gallons per minute or, for microirrigation, in gallons per hour.

**Foliage** – leaf material of plants.

**Goof plug** – manufactured repair plug for inserting into an unneeded outlet hole in the distribution tubing to result in a dependable seal.

**Horticulture** – science and art of growing fruits, vegetables, flowers and ornamental plants.

**Hydrozone** – plants grouped according to low, medium or high water requirements, served by one control zone of an irrigation system.

**Indicator plant** – plant with the highest daily water requirement in a zone or landscape, useful for signaling the declining moisture status of the group.

**In-line drip tubing** – type of microirrigation device utilizing poly tubing with preinstalled emitters at preset distances.

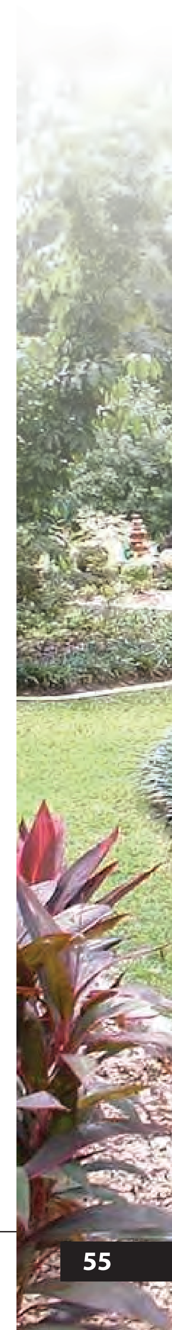
**Irrigation** – controlled, artificial application of water to cropland, lawn or landscape to supplement that supplied through nature.

**Irrigation controller (timer)** – a timing mechanism used to open and close valve(s) on a scheduled program.

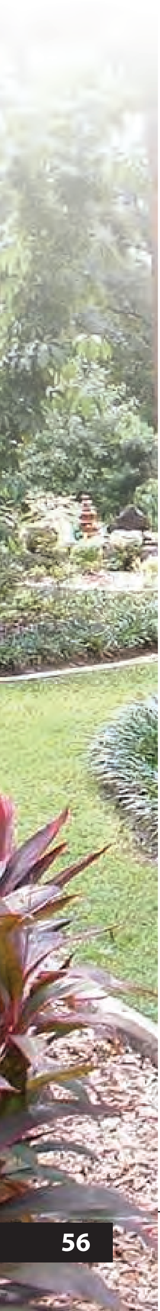
**Irrigation zone** – portion of an irrigation system operated from one control valve.

**Landscape** – planted areas that normally include turf, ground covers, flowers, shrubs, trees and similar plant materials, as opposed to agricultural crops.

**Microirrigation** – frequent application of small quantities of water directly on or below the soil surface, usually as discrete drops, tiny streams or miniature sprays through emitters placed along distribution tubing. Microirrigation encompasses a number of methods including drip, bubbler and low-volume spray irrigation.



# Glossary



**Micro-spray** – type of microirrigation device that applies water in preset spray patterns smaller than traditional spray heads.

**Mulch** – material spread onto the surface of soil to conserve moisture, regulate temperature and suppress weeds.

**Pressure regulating devices** – devices to ensure uniform water flow from each emitter operating from a common supply line regardless, within limits, of water pressure or elevation variations.

**Pressure tank** – optional small storage tank attached to well pump systems that can reduce frequent pump cycling.

**Pump cycling** – excessive on and off pumping operation because the irrigation zone's flow rate is lower than the pump's design flow rate. Causes rapid water pressure changes and could potentially damage the pump motor.

**Rain sensor device (also called rainfall shutoff device)** – device designed to interrupt or cease automatic irrigation operation after a predetermined amount of rain has fallen, and allows normal operation to automatically resume after the water evaporates.

**Reclaimed water** – domestic wastewater that has been permitted, treated and disinfected to a high degree so that it can be safely used for irrigation and other purposes, such as industrial process water and natural system restoration; reclaimed water is not intended for use as drinking water.

**Retrofit** – process of altering an existing irrigation system with microirrigation equipment.

**Runoff** – rainfall or irrigation that is not absorbed by the soil, but flows off the landscape into stormwater systems and surface water.

**Schematic** – diagram of an irrigation system plan.

# Appendix

## Formula to determine how long to run irrigation zones with micro-spray emitters

- The following equations and examples are provided to aid in determining proper irrigation run times to prevent over- or underwatering.
- An **average application** rate equation for micro-spray zones or in-line tubing zones can be used to determine irrigation duration.

### Step 1

**Average Application Rate (AAR) for Micro-Sprays:**

$$\text{AAR} = \frac{\text{Total Flow Rate (gph)} \times 1.6}{\text{Area}}$$

Where:

**AAR** = Average application rate in inches per hour (iph)
**Total Flow Rate** = Total flow of all emitters in one irrigation zone
**Area** = Square footage being watered
**1.6** = Conversion factor (converts gallons per hour to iph)

### Step 2

**Irrigation Run Time (IRT) for Micro-Sprays:**

$$\text{IRT} = \frac{\text{Application Amount} \times 60}{\text{AAR}}$$

Where:

**Application Amount** = Amount of water per application (gallons)
**AAR** = Average application amount (iph)
**60** = Conversion factor (converts iph to inches/minute)

* Figure 4.1 on p. 39 shows example scenarios for micro-spray calculations.

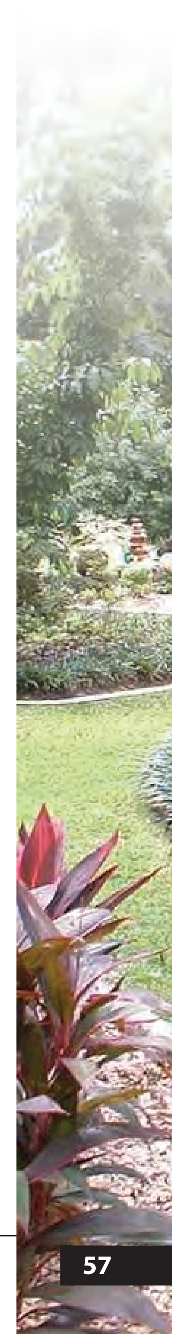
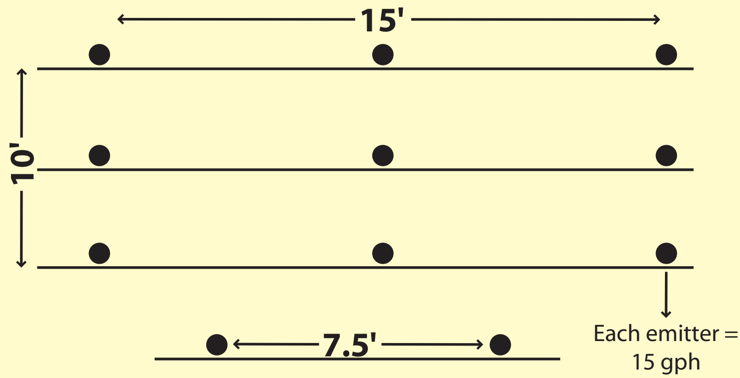


Figure 4.1 Example of Average Application Rate and Irrigation Run Time for Micro-Sprays:




**Question 1:**
If watering a 10' x 15' flower bed (a total area of 150 sq. ft.) with micro-sprays and the area has 11 micro-sprays that irrigate at 15 gph (11 x 15 ) = 165 gph
What is the average application rate? (AAR)

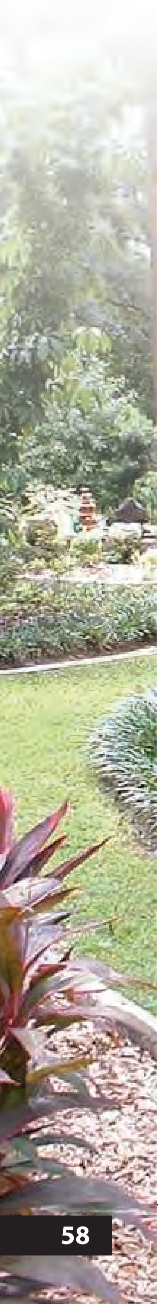
$$AAR = \frac{165 \times 1.6}{150} = 1.76$$

**Answer 1:**
The AAR would be 1.76 inches per hour (iph).

**Question 2:**
Based on the AAR, what is the irrigation run time (IRT) needed to apply .75 iph?

$$IRT = \frac{.75 \times 60 \text{ min.}}{1.76} = 25.6 \text{ minutes}$$

**Answer 2:**
If the plants are established, the general rule of applying ¾ (.75) to 1 inch of water per week is adequate. In the above example, a run time of 26 minutes will apply approximately .75 inches of water.



### *Formula to determine how long to run irrigation zones with in-line drip tubing*

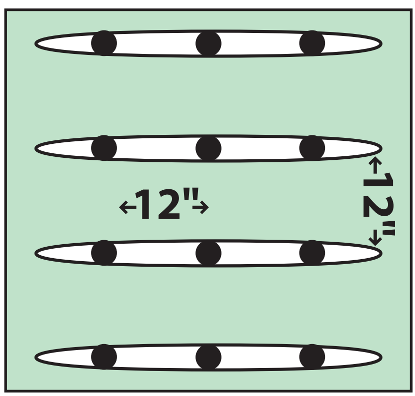
**Average Application Rate (AAR) for In-Line Tubing:**

$$\text{AAR} = \frac{231.1 \times \text{Dripper Flow (gph)}}{\text{Dripper Spacing} \times \text{Dripline Spacing}}$$

Where:

**AAR** = Average application rate in inches per hour (iph)
**Dripper flow** = Gallons per hour flow of one dripper
**Dripper spacing** = Spacing in inches of drippers inside tubing
**Dripline spacing** = Inches between tubing laterals
**231.1** = Conversion factor (converts gallon/hour to cubic inches/hour)

Figure 4.2 Example of Average Application Rate for In-Line Drip Tubing



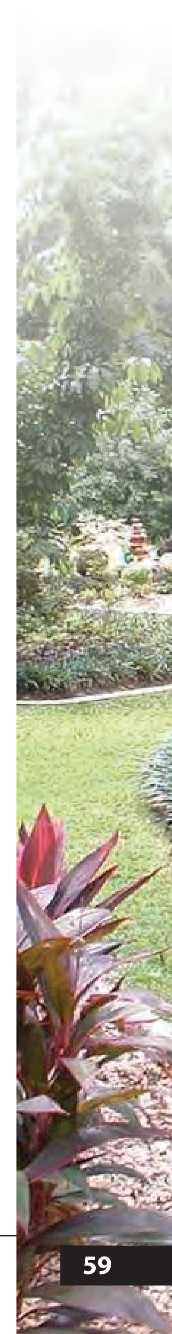

**If using emitters with a dripper flow rate of 0.9 gph:**

$$\text{AAR} = \frac{231.1 \times 0.9}{12 \times 12}$$

$$\text{AAR} = \frac{207.99}{144}$$

**AAR = 1.44 inches per hour**

* Remember, as plants become mature and established, they should be watered longer, but less frequently.



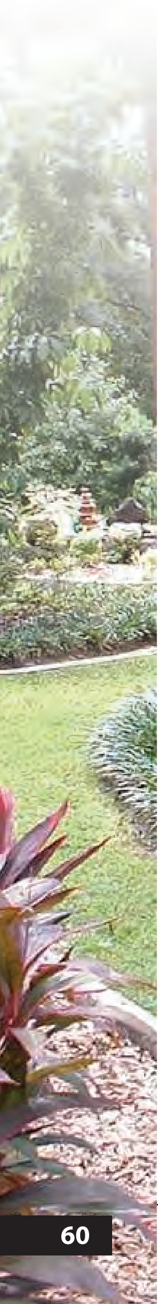


Table A.1 Example of Run Time Settings for Uniformly Distributed Microsprays at Various Application Rates

| Plot Area | Number of Microsprays | Flow Rate | AAR (in/hr) | IRT (min) for 0.75 in. | IRT (min) for 0.5 in. |
|---|---|---|---|---|---|
| 150 ft² | 10 | 5 | 0.53 | 84 | 56 |
| | | 10 | 1.07 | 42 | 28 |
| | | 15 | 1.60 | 28 | 19 |
| | | 20 | 2.13 | 21 | 14 |
| | | 25 | 2.67 | 17 | 11 |
| | | 30 | 3.20 | 14 | 9 |
| 300 ft² | 15 | 5 | 0.40 | 113 | 75 |
| | | 10 | 0.80 | 56 | 38 |
| | | 15 | 1.20 | 38 | 25 |
| | | 20 | 1.60 | 28 | 19 |
| | | 25 | 2.00 | 23 | 15 |
| | | 30 | 2.40 | 19 | 13 |

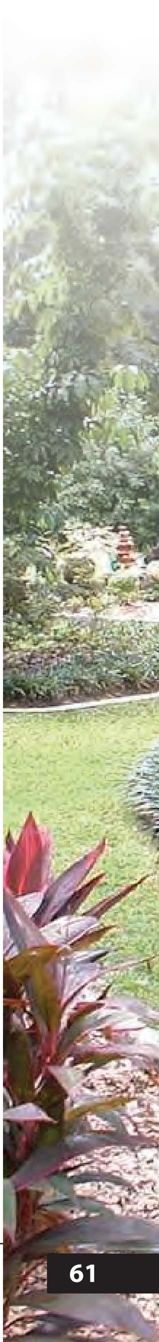
* Table A.1 displays calculated average application rates (AAR) and irrigation run times (IRT) for two example plot scenarios at different flow rates. See AAR and IRT equations and examples on pages 57 and 58 to determine microspray settings for individual landscapes.

* Manufactured microsprays have different flow rates and throw diameter ranges when operated at different pressures (psi). Due to variability in product specifications, contact manufacturers to determine the suitability of specific microsprays.

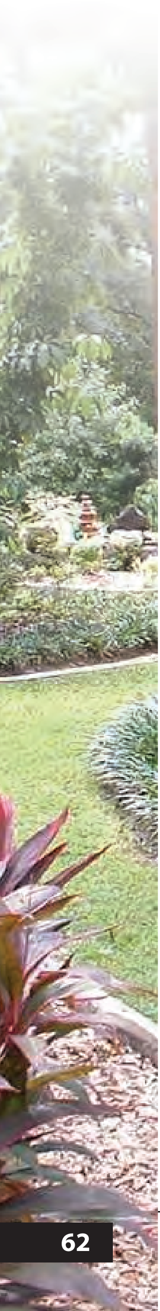
Table A.2 Example of Run Time Settings for Uniformly Distributed Drippers at Various Application Rates

| Dripper Spacing | Dripline Spacing | Dripper Flow (gph) | AAR (iph) | IRT (min) for 0.75 in | IRT (min) for 0.5 in |
|---|---|---|---|---|---|
| 12 in | 12 in | 0.5 | 0.80 | 56 | 37 |
| | | 1 | 1.60 | 28 | 19 |
| | | 1.5 | 2.41 | 19 | 12 |
| | | 2 | 3.21 | 14 | 9 |

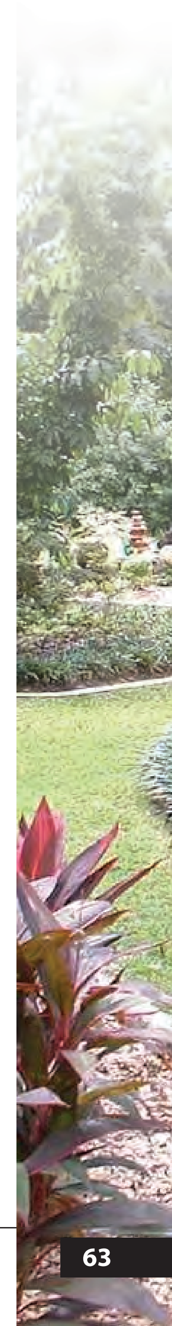
* Table A.2 displays calculated Average Application Rates and Irrigation Run times for an average range of dripper flow rates. The dripper spacing and dripline spacing used are based on optimum use for sandy soils (see Figure 3.2 on page 23).



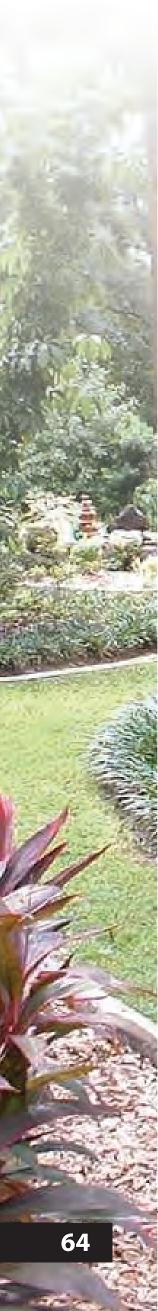
# Notes



# Notes



# Acknowledgements




Tampa Bay Water wishes to acknowledge the following contributors to Version 1 of this guide:

**Dale Armstrong**
Florida Yards & Neighborhoods Program, Pinellas County

**Dave Bracciano**
Tampa Bay Water

**Chris Claus**
City of St. Petersburg Water Resources Department

**Marina D'Abreau–Pryce**
Florida Yards & Neighborhoods Program, Hillsborough County

**Norman Davis**
Hillsborough County Water Resource Services

**Chris Dewey**
Florida Yards & Neighborhoods Program, Pasco County

**Jeannie Hayes**
Florida Yards & Neighborhoods Program, Pasco County

**Wilma Holley**
Florida Yards & Neighborhoods Program, Pinellas County

**Gail Huff**
Hillsborough Soil & Water Conservation District

**Carol Imbriani**
Tampa Bay Water

**Lisa R. Krentz**
City of Tampa Water Department

**Rhianna Pensa**
Tampa Bay Water

**Alison Ramoy**
Southwest Florida Water Management District

**Virginia Sternberger**
Southwest Florida Water Management District

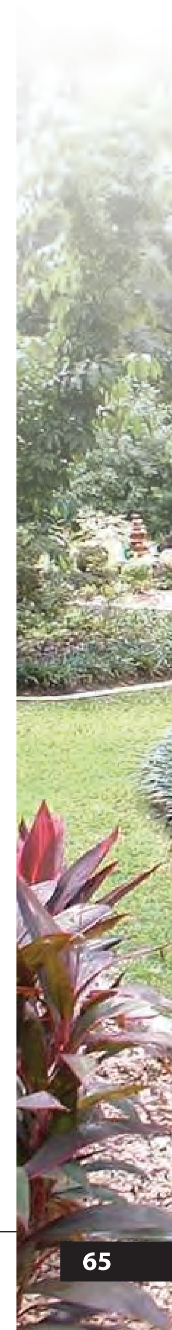
**Janice Sylvain**
Southwest Florida Water Management District

**Jack Tichenor**
Manatee County Extension Service

**Skip Wright**
Florida Irrigation Society

# References


1. Rainbird Sales, Inc., Landscape Drip Division 2000, Low-Volume Landscape Irrigation Design Manual p. 10.
2. Dorota z. Haman, Michael D. Dukes and Sydney G. Park-Brown, Institute of Food and Agricultural Sciences, University of Florida, Retrofitting a Traditional In-ground Sprinkler Irrigation System for Microirrigation of Landscape Plants, Document ABE324 (October 2002) p. 2.
3. City of Albuquerque, Public Works Department, Low-Volume Irrigation Design and Installation Guide, p. 10.
4. Rainbird Sales, Inc., Low-Volume Irrigation Design & Installation Guide, 1996, p.2.
5. Florida Extension Service, Institute of Food and Agricultural Sciences, University of Florida publications ENH 857 Irrigating Landscape Plants During Establishment (December 2002) p.5 and ENH 860 Fertilization and Irrigation Needs for Florida Lawns and Landscapes (January 2002) p.3.
6. Florida Irrigation Society, Know Your Irrigation Contractor.

UF UNIVERSITY of FLORIDA
IFAS Extension

Florida-Friendly Landscaping™ PROGRAM

TAMPA BAY WATER

PASCO COUNTY FLORIDA

Pinellas County

Hillsborough County Florida

st.petersburg
www.stpete.org

MANATEE COUNTY FLORIDA

fis
MANAGING EVERY DROP™

Tampa Water Department

Southwest Florida
Water Management District
WATERMATTERS.ORG • 1-800-423-1476