

Sunnylands Center & Gardens Irrigation Systems

Basic Description: Sunnylands Center & Gardens utilizes a variety of irrigation technologies that are beneficial to the health of the plants on site while maintaining water conservation goals.

System Specifics:

- Four different irrigation systems are utilized:
 1. K.I.S.S.S. irrigation
 2. Rain Bird XFS Subsurface Dripline
 3. Drip emitters
 4. Rotor sprinklers
- The site also utilizes a weather station and a state of the art satellite and computer system.



KISSS irrigation during installation

K.I.S.S.S. (Capillary Irrigation Sub-Surface System): The irrigation system infrastructure is entirely underground, approximately 4-6 inches below the surface with each line of tubing being spaced about 18 inches apart, slightly below the root zone of the plant. The system is made of a geo-textile fabric and when the water enters the system it leaves the emitter tubing, enters the geo-textile fabric, and when paired with the natural capillary action within soil, the water is absorbed in an upward and outward pattern to the root zone at a rate that is closer to the soil's natural absorption rate.

Benefits:

- The uniform wetting pattern more closely mimics natural capillary action and provides water directly to the area of the plant where it needs it most. This also allows the water to be absorbed by the plant at a more natural rate which is better for the health of the plant.
- The loss of water to evaporation in the desert is of extremely high concern. By installing the irrigation system underground the amount of water that is lost due to evapotranspiration is significantly less which results in less water use overall.

Problems/Warning:

- Careful consideration should be given to the soil types and plant species before this irrigation system is installed.
- This irrigation system has proven to be less effective in turf areas and has resulted in other irrigation strategies being utilized in areas with turf and KISSS only utilized in planting areas.
- There have been some problems on the historic estate with weed intrusion into the KISSS lines.
- One of the problems that have been discovered with this system specifically on our site has to do with the extremely high infiltration and percolation rates, which is characteristic of the sandy soils in the area. Due to the extremely fast rate the system is unable to create the desired uniform wetting pattern. This has led to the appearance of striping or rows of green grass over the area where the KISSS system was installed and rows of yellowing grass in the area between. This has not proven to be as big an issue in the non-turf areas where the system is utilized in the Gardens probably due to the close proximity of the root zone to the KISSS lines. The plants are able to utilize the water provided by the KISSS system far more effectively than the turf.

Rain Bird XFS Subsurface Dripline: This system was installed in the Performance Circle and the two squares of turf located in between the twin reflecting pools. This system is the Rain Bird version of the KISSS irrigation system with a few distinct differences that have proven this form of the technology to be the more effective version of the system for our specific site conditions and operational needs. The system is comprised of a copper colored hose that has emitters, from which water is dispersed, at even spaces throughout the tubing (looks very similar to the KISSS system except that it does not have the geotextile fabric surrounding the tubing).

Benefits:

- This system is installed, as is KISSS, at depths of approximately 4-6 inches below the surface. Each line of tubing is spaced approximately 10 inches apart. This works to help reduce the amount of water that is lost to evaporation and, like the KISSS system, is designed to deliver water directly to the root zone of the plant in a uniform wetting pattern so that it can be most efficiently and effectively utilized by the plant.
- This system has a patent pending Copper Shield Technology that acts to prevent root intrusion without the use of the harsh chemicals that are used in other irrigation designs.
- The system also has a low-profile emitter design that reduces in-line pressure loss that allows for longer lateral lines during installation.
- XFS Subsurface dripline is resistant to clogging due to the use of extra wide flow paths combined with a self-flushing function.
- The tubing is designed with dual-layering (copper over black) that helps to provide extra resistance to chemicals, algal growth, and UV damage all resulting in less long-term maintenance needs for the system.
- The dripline has a pressure-compensating emitter design that provides a consistent flow over the entire length of the tubing that helps to ensure higher uniformity for increased reliability in pressure.
- The system is being operated now in a manner in which there are small bursts of water that are released every fifteen minutes. This helps to create a uniform saturation pattern and maintain that pattern so that the water can be very efficiently accessed and utilized by the turf.

Problems/Warnings:

- While this system has proven to be more effective in the areas in which it was installed, it is still a relatively new technology to the site and data will continue to be collected to determine the true effectiveness, benefits, and problems that might occur with this type of irrigation system.

Drip Emitters: This is an above ground system that delivers water near the root zone of the plant above the surface. If you look through the Gardens to find areas that are irrigated by emitters (all the trees and *Leucophyllum* in the Gardens are on the emitter system) you will find that each plant has two emitters. This double emitter system was designed so one or both of these emitters can be turned on as needed.

Benefits:

- Low volume system that delivers a more uniform wetting pattern than the traditional rotor sprinkler system which allows the plant to utilize the water provided more efficiently resulting in the need to water with less frequency. This also helps to reduce the amount of water loss to evaporation.
- When a drip emitter system is running properly there is the elimination of water run-off.
- The system can be run during periods of high winds without a significant loss or displacement of water.

Problems/Warnings:

- Careful consideration should be given to the soil types and the plant species before any irrigation system is installed.
- With drip emitter systems it is often hard to determine how much water has been delivered to the plant often times resulting in under or overwatering of plants. This can be resolved with the use of indicator devices or with automated systems, like we have here.

Rotor Overhead Sprinkler System: This is a system of rotor sprinkler heads that pop-up from below the surface of the ground and distribute water through a uniform spraying pattern across an area. At Sunnylands Center & Gardens this type of system is only utilized for the Great Lawn and in the wildflower field. This type of irrigation system is used almost entirely on the historic estate, especially the golf course.

Benefits:

- When properly installed and maintained, these systems can allow for a very even distribution of water over a large area.

Problems/Warnings:

- There is a great deal of water that can be lost due to evaporation with these systems.
- During periods of extreme wind conditions, there can be a great deal of water lost or displaced.
- With these types of systems there is an increased risk of run-off.

Additional Information:

- The Sunnylands Center & Gardens irrigation system, as well as the irrigation system for the estate, is controlled via satellite. There is a central computer located at the Maintenance Yard and radio type controllers that are used by the maintenance staff on-site to control when, where, and for how long the water is on.
- One of the other essential features of the Sunnylands irrigation system is the weather station. This provides readings on temperature, humidity levels, and [evapotranspiration rates](#) that allow the Sunnylands maintenance staff to make highly informed decisions daily on watering needs.
- The Gardens was designed in 140 individual irrigated zones. These zones contain plants that have similar watering needs. All of the zones have only one type of irrigation system in them. They are either all drip emitters, all KISSS, or all rotors. This allows the maintenance staff to have a great deal of control over the irrigation system. If there is a certain section that needs additional water they are able to turn on only that section while leaving all of the other sections of the system turned off. This allows them to cater more efficiently to the needs of each of the individual species while maintaining the water conservation goals for the site.
- The irrigation system for the Gardens was installed with the entire necessary infrastructure (purple pipe system) to begin utilizing recycled or reclaimed water as soon as it becomes available to us. [Recycled or reclaimed water](#) should become available to the site at the completion of the Mid-Valley Pipeline. Once this water has become available, the goal is to rely almost entirely on that water for irrigation instead of pulling from the wells that are located on the estate.

Resources:

- KISS America (kissusa.com)
- Rain Bird (rainbird.com)
- Coachella Valley Water District CVWD (cvwd.org)
- Colorado State University Extension, *Drip Irrigation for Home Gardeners Fact Sheet* (www.ext.colostate.edu/pubs/garden/04702.html)
- *Capillary Action*, The USGS Water Science School (<http://ga.water.usgs.gov/edu/capillaryaction.html>)
- *Understanding Irrigation Management Factors*, Colorado Master Gardener Program through the Colorado State University Extension (www.ext.colostate.edu/mg/Gardennotes/263.pdf)
- *How Water Moves Through Soil: A Guide to the Video*, Cooperative Extension College of Agriculture The University of Arizona, <http://cals.arizona.edu/pubs/water/az9516.pdf>
- Soil Water (<http://www.soils.wisc.edu/courses/SS325/soilwater.htm>)
- *Soil Water*, Plant and Soil Science eLibrary (<http://passel.unl.edu>)

Glossary:

Emitter: The opening from which water transported from the tubing or line is released to the desired irrigated area, generally at the root zone, in a controlled manner.

Geo-textile Fabric: also known as filter fabric, these are permeable fabrics that are designed to aid with the filtration of water while preventing the erosion of soil and sand. These fabrics have a variety of other applications in a wide variety of fields. (<http://en.wikipedia.org/wiki/Geotextile>)

Capillary Action: movement of water through porous spaces due to adhesion (water molecules sticking to other substances), cohesion (water molecules sticking together), and surface tension. Capillary action occurs when the forces of adhesion (water molecules sticking to other substances) are greater than the forces of cohesion (water molecules sticking to each other) causing water to move up and out. This is what you are seeing when you hold a dry paper towel just above a bowl of water and before you know it the whole paper towel top to bottom is wet. Capillary action is different in different types of soils because the water-holding capacity of the soils differs based on the pore size of the aggregate materials within the soil. The larger the pores within the soils the more heavily water movement will be dictated by gravitational forces than capillary forces. When the gravitational forces are greater than that of the capillary forces the water will move downward faster creating a narrower deeper pattern of water saturation. Sandy soils like the soils that we have here on site have very large pores. As a result subsurface irrigation can have significant challenges.

Infiltration Rate: the movement of water into the soil from above. This is highly influenced by the pore size of the soil. Sandy soils, like the ones that we have here, have very large pore size. In contrast, soils that are more clay in composition have very small pore sizes and therefore the water does not move into the soil from above as quickly as it does in sandy soils.

Percolation Rate: the rate at which infiltrated water moves downward through the soil. This is highly influenced by the pore size of the soil and sandy soils, like the ones that we have here, have very large pore size. In contrast soils that are more clay in composition have very small pore sizes and therefore the water does not move through the soil as quickly as it does in sandy soils.

Run-off: additional water that is not absorbed into the ground in the area desired. In areas where you see sprinklers running and water running down the street; that is considered runoff. This is undesirable not only because of the waste of water, but as water moves from one area to another, it will pick up chemicals, fertilizers, pesticides, etc. and move them to other areas, even into local water supplies.

Evapotranspiration Rates (ET_0): the rate at which water is evaporating from the ground's surface and the rate at which plants are transpiring (releasing water into the atmosphere, similar to our breathing process). (<http://ga.water.usgs.gov/edu/watercycleevapotranspiration.html>)

Recycled or Reclaimed Water: generally defined as waste water, from the public sewage system, that has been treated to a high standard at a treatment plant and then distributed in separate pipes from the main water supply. Systems that distribute recycled water often utilize purple colored pipes and fittings to make them easily distinguishable. According to the Coachella Valley Water District website, the water that is supplied from the first completed phase of the Mid-Valley Pipeline (and will be supplied to us from the completed phases in the future) brings imported water from the Coachella Canal to a water reclamation plant in Palm Desert where it is blended with recycled water and then distributed for use. It is important to note that recycled/reclaimed water differs greatly from that of gray water. Gray water is water that is collected on a site from household type activities such as washing machines, showers, and tap water from all areas except the kitchen and the toilet. Gray-water is typically not treated and is directly re-used on the site without ever leaving.