H1/ Landscape, Irrigation, Water Budget Overview

H2/1.0 Introduction

PLACHEHOLDER Photo 1 Person Designing Landscape Plan

PLACHEHOLDER Photo 2 Sustainable Landscape Front Yard

This pictorial guide gives the reader a foundation for what makes a sustainable landscape. It covers the elements of a landscape and how they work together. This information is intended to help people comply with the State of California's 2015 Model Water Efficient Landscape Ordinance.

Soil, plants, irrigation, water features, and hardscapes are common elements in a landscape. Landscapes are living, dynamic ecosystems that require thoughtful planning, careful installation, and proactive maintenance to function properly. They are complex. Yet, they are a vital part of every community's livability and sustainability. The soil, water, plant relationship is essential for a thriving and healthy landscape that is less susceptible to disease and drought and requires less resources.

H2/1.0 Soil

Healthy soil is necessary for healthy plants. Plants need the right amount of air, water and nutrients which can be achieved through the appropriate application of compost, mulch, and irrigation.

Healthy soil contains 25% air, 25% water, 5% organic material, 45% mineral, and living organisms, such as bacteria, fungi, protozoa, yeasts, algae, nematodes, worms and more. The "soil food web" is the network where nutrients pass from one organism to another. It is essential for plant health.

PLACEHOLDER Photo 3 Person Applying Compost on Soil

Organic matter that decays in the soil plays a large role in the soil food web, because it provides the nourishment for organisms; makes the soil like a sponge to hold more water; and binds the soil particles together.

There are three main types of soil particles: sand, silt, clay. The relative percentages of each particle give the soil its "texture." Soil structure refers to how the soil particles are clumped together. Loam is considered "ideal," because its structure is almost equal parts sand, silt and clay and allows the right mix of air, water, organic matter, and minerals. Sand is very porous, and clay is tightly bound. To get the best soil conditions, compost or other amendments may be recommended after a soil test and analysis is performed.

H3/1.0 Compost

PLACEHOLDER Photo 4 Compost

Compost is decomposed organic matter (grass, manure, food scrapes, leaves, wood chips) that is incorporated (tilled or amended) into the soil before planting to provide nutrients to the plants; create necessary space for air and water around the roots; and regulate temperature. This opening up between soil particles allows the plant roots to spread easier and is called "friable soil."

In clay soils, compost reduces compaction, improves drainage and provides nutrients. In sandy soils, compost retains more water and nutrients and increases organism activity. These improvements reduce the need for irrigation and fertilizers.

H4/1.0 Types of Compost:

Compost can be purchased in bulk (cubic yards), in bags or created on-site.

When selecting compost consider using quality organic compost such as CDFA-registered Organic Compost or OMRI-certified Compost which meet strict requirements.

PLACEHOLDER Photo 5 Compost being Tilled into Soil

H3/1.1 Mulch

PLACEHOLDER Photo 6 Mulched Shrub Bed

Mulch is organic (leaves, bark, straw, compost) or inorganic material (rocks, gravel, decomposed granite) used as a "dressing" that goes on top of the bare soil to reduce erosion, evaporation, and weeds. Organic mulch decomposes over time adding additional nutrients to the soil. Mulch should be applied to the entire planting area but kept several inches away from plant stems and tree trunks to keep the base dry which helps prevent moisture borne plant disease.

H4/1.0 Types of Mulch:

Organic, Recycled Content Mulch:

*Tree trimmings/wood chips – usually 2-3 inch pieces; don't hold together; prone to migration; may absorb water from soil until decomposition begins.

PLACEHOLDER Photo 7 Wood Chip Mulch

*Stabilized/coarse composted/walk-on mulch- usually long, fine shredded bark and wood that weaves together to create a blanket; holds together and doesn’t migrate; good for bioretention/stormwater retention and to prevent soil erosion.

PLACEHOLDER Photo 8 Walk-on Mulch

*Pallet Mulch or Dimensional Lumber– recycled and shredded wood pallets or pre-cut lumber used for framing.

PLACEHOLDER Photo 9 Pallet Mulch

Inorganic Mulch:

*Decomposed granite

*River rock, small stones, gravel, pebbles

Inorganic mulch may be required in fire hazard areas.

Types of Mulch To Avoid:

*Gorilla hair bark.

*Virgin materials.

*Ground up tires.

*Playground fiber.

Resources:

For more information about soils, see the Urban Soil Primer: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052836.pdf

StopWaste: http://www.stopwaste.org/at-work/built-environment/landscapes/water-efficient-landscape-ordinance

CalRecycle: www.calrecycle.ca.gov

Compost for:
California: https://www.compostingcouncil.org/page/participants#CA
Compost for Bay Area: www.lawntogarden.org/marketplace

US Composting Council: https://www.compostingcouncil.org

OMRI: https://www.omri.org/about-omri-listed-products

H3/1.2 Testing Soil

PLACEHOLDER Photo 10 Person Taking Soil Sample

A soil test shows what the soil is made-up of and recommendations to make it optimal for healthy plants. This type of soil report is not a Geotech or geology report. The soil samples are sent to a soil laboratory for testing and analysis. The lab will explain how to collect the samples. A report is provided with recommendations. A sample soil report can be found in Appendix J

Resource: Soil testing labs in California
http://ccmg.ucanr.edu/files/51308.pdf

H2/1.1 Plants

PLACEHOLDER Photo 11 Front Yard With Parkway (no turf)

PLACEHOLDER Photo 12 Office Building Landscape (no turf)

PLACEHOLDER Photo 13 Sports Field

The right plant for the right place- choosing plants including shrubs, lawn, trees, ediblesrequires an understanding of the conditions where they will be planted. Choosing a plant that's not compatible with those conditions will take a lot of life support and doesn't guarantee that it will survive and thrive. This is waste of time, resources, and money.

PLACEHOLDER Photo 14 CA Native Rose Blooming

Caption: Scientific and Common Name of flower in Photo

Knowing the microclimate (conditions at the project site) is critical for identifying which plant would fit-in and thrive. Choosing plants based on the soil conditions (or amending it to meet the plant's needs), sun exposure, temperature, watering needs, distance from other plants, and adjacent structures is essential for their success.

PLACEHOLDER Photo 15 Shrub bed in front of fence or building

H3/1.0 Selecting Plants

There are many types of plants: native to California, non-native, non-native but adapted to this climate (plants from other Mediterranean climates) or invasive. Plants that are native or climate-appropriate need less irrigation water and in many cases less maintenance. Plants not adapted to the local climate and conditions will be on life support. They will need more water, more maintenance, and more resources to keep them alive and thriving. Plant selection should be determined by the "Right Plant, Right Place" principle.

Figure 1. The garden\garden Demonstration Garden Results

PLACEHOLDER Figure 1 garden\garden graph

Researchers have developed a list of plants based on their water needs: very low, low, moderate, and high. DWR has approved the Water Use Classification of Landscape Species (WUCOLS) plant database for use in calculating the water budget. WUCOLS provides plants' watering needs and assigns a Plant Factor number from 0 to 1.0. Zero is a plant that does not need irrigation (gets all its water from rain) to 1.0 which is a high water use plant, like some lawns. Plants should be grouped together according to a

Plant Factor and separated into different irrigation zones (valves) according to the water requirement.

PLACEHOLDER Photo 16 Screen Shot of WUCOLS

In fire-prone areas, careful consideration must be made for the types of plants and materials around buildings. There are plants that are more fire resistant than others. Check with your city and county for regulations.

California native plants can be found in many nurseries throughout the State. Some have been bred or hybridized to be smaller than the parent plant. Some natives don't need or like summer watering, because they are dormant (but can still be green).

PLACEHOLDER Photo 17 Matilija Poppy

Caption: Scientific and Common Name of Flower in Photo

Lawn, turf, grass, turfgrass is considered a grass that is mowed.

Cools season grass can tolerate colder temperatures:

*Annual bluegrass.

PLACEHOLDER Photo 18 Annual bluegrass

*Kentucky bluegrass.

PLACEHOLDER Photo 19 Kentucky bluegrass

*Perennial ryegrass.

PLACEHOLDER Photo 20 Perennial ryegrass

*Red fescue.

PLACEHOLDER Photo 21 Red fescue

*Tall fescue.

PLACEHOLDER Photo 22 Tall fescue

Water season grass tolerates warmer weather better:

*Bermuda grass.

PLACEHOLDER Photo 23 Bermuda grass

*Kikuyugrass.

PLACEHOLDER Photo 24 Kikuyugrass

* Seashore Paspalum.

PLACEHOLDER Photo 25 Seashore Paspalum

*St. Augustine.

PLACEHOLDER Photo 26 St. Augustine

*Zoysiagrass.

PLACEHOLDER Photo 27 Zoysiagrass

*Buffalo grass.

PLACEHOLDER Photo 28 Buffalo grass

Lawn alternatives are ground covers that don’t need to be mowed, including native grasses and some grass seed mixtures that need less water.

PLACEHOLDER Photo 29 Dymondia

Caption: Caption: Scientific and Common Name of plant in Photo

Trees provide many benefits including shade and energy savings, habitat creation, oxygen, carbon sequestration, erosion control, and stormwater infiltration. Just like shrubs, choosing the right tree for the right space is crucial. Knowing the mature size of a tree will ensure it has the space it needs and the right amount of water.

Research showed that shade trees reduced the energy needed to cool a home by 30%. Other studies have shown that street trees increase the home sale value between $7,000 and $13,000. Trees are a great investment.

PLACEHOLDER Photo 30 California Willow Tree

Caption: Caption: Scientific and Common Name of tree in Photo

Invasive plants can overpower other plants and spread causing problems like destruction of native plants and habitats, soil erosion, act as fire kindling, and cause aquatic disruption. Some plants may be more invasive in one part of the state but not another.

PLACEHOLDER Photo 31 Nassella tenuissima or Mexican Feather Grass

Caption: Caption: Scientific and Common Name of tree in Photo

PLACEHOLDER Photo 32 Washingtonia robusta or Mexican Fan Palm

Caption: Caption: Scientific and Common Name of tree in Photo

Plant establishment is the time it takes for the plants to reach maturity and have roots that have spread into the native soil, which is usually one to two years. This will be important in determining when and how often you water after plants are installed. The irrigation and water budget sections below will go into more detail.

Resources:

WUCOLS: https://ucanr.edu/sites/WUCOLS/

Evapotranspiration - CIMIS: https://cimis.water.ca.gov/

California Native Plant Society: https://www.cnps.org/

California Invasive Plant Council: https://www.cal-ipc.org/plants/horticulture-plants/

Southern California, Be Water Wise: https://www.bewaterwise.com

H2/1.2 Irrigation

All plants need water.

PLACEHOLDER Photo 33 Sprinklers Watering Garden

A plant takes in water and transpires (plant sweat) it. Water also evaporates from the soil.

PLACEHOLDER Graphic 1 Evapotranspiration

Transpiration + Evaporation = Evapotranspiration (ET)

Irrigation is water applied to plants if rain cannot meet all of their water use needs. Determining the Evapotranspiration for plants is part of the equation to calculate how much irrigation water is needed throughout the year.

Irrigation is outdoor plumbing. If not properly designed, installed, and maintained, it can create a public health and safety hazard like polluted water, slippery hardscapes, and water damage to buildings, sidewalks, streets, in addition to wasting water.

PLACEHOLDER Photo 34 Eroded street

PLACEHOLDER Photo 35 Water Pooling on Sidewalk

PLACEHOLDER Photo 36 Water Damaged Fence

PLACEHOLDER Photo 37 Stucco Peeling from Sprinkler

There are manual (e.g. garden hose) and automatic irrigation systems which can be permanent or temporary (e.g. drip to get native plants established). There are many components to an automatic irrigation system. There are differences between single-family home or small commercial and large landscapes. The diagrams below show the anatomy of both types of systems and the differences.

Choosing the right irrigation components is dependent on:

*Soil conditions – how much water the soil can absorb before it overflows.

*Plant type and coverage – large swaths of groundcover and lawn versus shrubs and trees.

*Grading – slopes and depressions may cause runoff or ponding.

To create the water budget for each landscape, the water needs, evapotranspiration and irrigation efficiency are needed. These budgets not only help the property owner maintain the landscape but also help water utilities forecast future water demand and system capacity.

Water budgets are only required for projects that need to follow the MWELO Performance Pathway. A Water Budget Calculator is available and a sample can be found in Appendix G.

H3/1.0 Water Sources

Irrigation systems may use potable (drinking water) and non-potable (not drinkable) water supplies and/or a combination depending on what is allowed by the local permitting agency and local health department. Non-potable supplies may include graywater, rainwater, and recycled water. Check with your city or county to understand the terminology, requirements and permitting process for landscape projects that propose using alternative water supplies. Some definitions can be found in MWELO.

PLACEHOLDER Photo 38 Rain Barrel

PLACEHOLDER Photo 39 Cistern

PLACEHOLDER Photo 40 Recycled Water Irrigation System

H3/1.1 Anatomy of Irrigation Systems

PLACEHOLDER Graphic 2 Diagram of Residential Irrigation System

PLACEHOLDER Graphic 3 Diagram of Non-residential Irrigation System

H3/1.2 Key Terms

Irrigation systems are made up of many devices and components. These components are affected by different variables. Before the individual components are explained, there are a few terms to know.

Flow rate – The volume of water flowing through an area. It is measured in gallons per minute (GPM) or gallons per hour (GPH).

Pressure – The force that pushes water through an area. It is measured in pounds per square inch (PSI).

Precipitation rate - The speed at which the irrigation water is applied over an area. It is also called the "application rate." It is measured in inches per hour.

Distribution uniformity –how evenly irrigation water is applied over an area. Distribution uniformity (DU) for the lower quarter (DULQ) is the ratio of the average measurements in the lowest quarter of samples to the average of all samples. Some resources consider DULQ of 0.85 or more excellent; 0.75 good; 0.65 minimal; less than 0.65 poor. Minimizing low pressure and proper spacing can improve distribution. Distribution uniformity is one factor of Irrigation Efficiency.

Irrigation Efficiency (IE)–is the ratio of the amount of water beneficially used versus the amount of water wasted. Irrigation efficiency depends on both DU and irrigation management efficiency (IME) through scheduling. Many people substitute DU for efficiency, but the management of a system is just as vital. Scheduling the irrigation cycles to meet the needs of plants and preventing runoff is an indicator of an efficient system.

Emission Device – A device that emits water over an area. There are three main types of emission devices: sprinklers, microirrigation and bubblers.

H2/1.3 Irrigation System Components

Irrigation system components can be found in big box stores and specialty irrigation supply stores.

Water Meter: A dedicated meter (owned and maintained by a water utility) or private meter/sub-meter (owned and maintained by property owner) measures the amount of water going into the irrigation system. If installing a private meter/sub-meter it must be calibrated using manufacturer instructions.

PLACEHOLDER Photo 41 Dedicated Irrigation Water Meter

PLACEHOLDER Graphic 4 Water Meter Legend Symbol

Point of Connection: Point where the irrigation system taps into the main water supply (private well or water utility service line).

PLACEHOLDER Photo 42 Point of Connection

PLACEHOLDER Graphic 5 Point of Connection Legend Symbol

Manual Shut-off Valve: A device that controls the flow of water that is installed after the point of connection and is manually turned off in the event of an emergency, thereby eliminating the shutoff of water inside the property. Can be a gate, ball, disk, or butterfly valve.

PLACEHOLDER Photo 43 Gate Valve

PLACEHOLDER Graphic 6 Gate Valve Legend Symbol

Backflow Prevention: A device that allows water to flow one way to prevent polluted or contaminated water from the irrigation system flowing in the opposite direction. This is also called “cross-connection control.”

It may be necessary to check with the local health department and/or water utility to determine which of these maybe required or prohibited for potable and non-potable water sources. There five types of irrigation backflow prevention devices.

*Reduced Pressure (RP) – Considered the highest protection and typically used for all commercial projects including apartments and condos; requires annual inspection; must be installed at least 12 inches above ground and upstream of all control valves; most expensive; manufacturer’s pressure loss information should be used.

PLACEHOLDER Photo 44 Reduced Pressure

*Anti-siphon Valve (ASV) – Most commonly used in single-family homes and must be installed at least 6 inches above the highest sprinkler/rotor/dripline. This combines the backflow with the control valve; no valves can be installed downstream; least expensive.

PLACEHOLDER Photo 45 Anti-siphon Valve

*Atmospheric Vacuum Breaker (AVB) – If installed there must be one after each control valve at least 6 inches higher than the highest spray, rotor, and drip.

PLACEHOLDER Photo 46 Atmospheric Vacuum Breaker

*Pressure Vacuum Breaker (PVB) – Must be installed at least 6 inches above the highest spray, rotor, drip and typically only one is installed upstream of the control valves.

PLACEHOLDER Photo 47 Pressure Vacuum Breaker

*Double Check Valve Assembly (DCVA) – Depending on local or county codes, a DCVA may be installed at least 12 inches above grade and upstream of the control valves.

PLACEHOLDER Photo 89 Double Check Valve Assembly

Pressure Regulator: A device that regulates incoming water pressure to meet emission device (spray, rotor, drip, bubbler) manufacturer recommendations. The water supply for the irrigation system is pressurized. The regulator may need to increase (booster pump) or decrease pressure (pressure regulation or compensation), so the device operates properly. The regulator may be a master pressure regulator for the entire system or found in the individual emission device. The flow rate of the regulator must match the system requirement.

PLACEHOLDER Photo 48 Pressure Regulator

PLACEHOLDER Graphic 7 Pressure Regulator Legend Symbol

Optimal pressure is what the manufacturer recommends. Design operating pressure is the pressure while the system is running/operating. Static pressure is the pressure of the water when the irrigation is not operating. Dynamic pressure is the aggregate of friction losses and elevation losses or gains. Hydraulic calculations at the design phase, especially for large projects or areas prone to fluctuations, help ensure those issues are addressed before they arise during and after construction. Flow rate and pressure are directly related to one another.

Emission device pressure: For rotors, this is about 45 psi, with an operating range of 25 to 65 psi. For sprinklers with fixed spray, it is 30 psi with an operating range of 15 to 30 psi. For sprinklers with rotary nozzles, it is 40-45 psi with operating range of 25 to 55 psi. For dripling/inline drip, this is about 40 psi with an operating range of 20 to 60 psi. For point-source drip,this is about 30 psi with an operating range 15 to 60 psi.

Master Shut-off Valve (Master Valve): A device installed upstream of control valves that can be shut-off to avoid water waste from leaks and/or broken valves, sprinklers, and/or pipes. It turns the water off for the entire irrigation system. In large projects with more than one point of connection, there may be more than one master shut-off valve. When connected to a flow sensor, the master valve will automatically turn off the system or zone when abnormal flow conditions are detected.

PLACEHOLDER Photo 49 Master Shut off Valve

PLACEHOLDER Graphic 8 Master Shut off Valve Legend Symbol

Flow Sensor: Device installed after the master valve that measures the rate of water flow – low and excessive. When connected to an appropriate controller, it can send an alert (some by text and/or email) when there is leak and some systems can shut-off the master valve or shut-off the zone where the issue is occurring. However, its full water-saving capabilities are only realized when it is paired with an automatic master valve that turns off the system or zone. Some devices are hard-wired and trenched underground and others are wireless, thus pricing varies. In some areas, wireless issues prevent proper operation or require wireless boosters. In large projects there may be more than one flow sensor.

PLACEHOLDER Photo 50 Flow Sensor

PLACEHOLDER Graphic 9 Flow Sensor Legend Symbol

Automatic Controller: A device that automatically turns on and off the control valves based on specific parameters and conditions. Some controllers can be programmed and operated from a cell phone and/or computer. Controllers with non-volatile memory retain the current date, time and programming when the power is interrupted and without a battery. They are also called timers or clocks. For MWELO they must have one of these functions:

*Weather-based Irrigation Controller (WBIC) – Also called a "smart controller." It adjusts the watering schedule using weather data that may be on-site or off-site data, historical weather data or real-time monitoring. It is like a thermostat for the landscape. Some require WiFi or cellular connection. EPA WaterSense labels these devices for water efficiency and reliability.

*Soil Moisture Sensor – Measures the moisture in the soil to adjust water schedules. If there are variations in soil types (one area is loam and another is clay) and plant material (turf and natives), additional soil moisture sensors may be needed to accurately control the irrigation system. Currently, there are no EPA WaterSense labeled soil-moisture sensors.

PLACEHOLDER Photo 51 Weather Based Controller

PLACEHOLDER Photo 52 Soil Sensor Controller

PLACEHOLDER Graphic 10 Irrigation Controller Legend Symbol

Programming these controllers requires some basic information about the landscape conditions and irrigation equipment. The Water Efficient Landscape Worksheet provides key information for each zone that can be used for programming.

Sensors: Device that shuts-off or interrupts the controller based on unfavorable conditions that could cause water waste such as rain, wind, and freezing. In areas where these are a regular factor, these additional water-saving devices are recommended. For MWELO a rain sensor is required.

*Rain Sensors – Are mounted outside and typically collect and measure rain. Depending on the amount of rain determines if the controller is stopped, interrupted or remains on. The sensor must be located where eaves or other structures do not block rainfall.

*Wind Sensors – Are mounted outside and measures wind speed and interupt the system during high wind conditions.

*Freeze Sensors – Are mounted outside in an area that is prone to freezing and will interrupt the controller when temperatures fall below freezing.

PLACEHOLDER Photo 53 Rain Sensor

PLACEHOLDER Graphic 11 Rain Sensor Legend Symbol

Pipes: PVC or Poly pipes transport water from the main water source to the emission devices. Schedule 40 and Schedule 80 pipe are commonly found in irrigation systems. Additional requirements may be required for non-potable water supplies. Main lines connect the Point of Connection to the valve manifold and is under constant pressure. Lateral lines connect the valve malifold to the emission device. Both main lines and lateral lines are buried underground.

PLACEHOLDER Photo 54 Lateral Pipe

PLACEHOLDER Graphic 12 Lateral Pipe Legend Symbol

Joints: PVC or Poly pipe connectors.

PLACEHOLDER Photo 55 Irrigation Joints

PLACEHOLDER Graphic 13 Irrigation Joints Legend Symbol

Valve Box: Covers valves buried underground.

PLACEHOLDER Photo 56 Valve Box

PLACEHOLDER Graphic 14 Valve Box Legend Symbol

Isolation Valve: A manual device that controls the flow of water to a section of the irrigation system and is installed upstream of the control valves.

PLACEHOLDER Photo 57 Isolation Valve

PLACEHOLDER Graphic 15 Isolation Valve Legend Symbol

Control Valve (Automatic Valve): Device that turns the emission devices (spray, drip, etc.) on and off. Remote Control Valves are electric solenoid valves operating on 24 volts that automatically turn on and off when hooked-up to an automatic irrigation controller. Valves can be plastic or brass.

*In-line valve (globe, angle) – Typically installed in commercial landscapes; buried underground in a valve box.

*Anti-siphon valve – Typically installed in single-family landscapes and combine the automation and backflow prevention; must be installed at least 6 inches above highest emission device.

PLACEHOLDER Photo 58 In-line Valve Buried

PLACEHOLDER Photo 59 Anti-siphon Valve in Yard

PLACEHOLDER Graphic 16 Control Valve Legend Symbol

Manifold: The combination of the lateral pipe and control valves.

PLACEHOLDER Photo 60 Manifold Assembly

Quick Coupler Valve: A device installed from the lateral line for easy access to the irrigation system. This may be used to flush the system or connect a hose for watering.

PLACEHOLDER Photo 61 Quick Coupler Valve

PLACEHOLDER Graphic 17 Quick Coupler Valve Legend Symbol

Hose Bib: A pipe where a garden hose is attached.

PLACEHOLDER Photo 62 Hose Bib Valve

PLACEHOLDER Graphic   Hose Bib Valve Legend Symbol

H3/1.0 Emission Devices

Emission Devices: A device that emits water over an area. There are three main types of emission devices: sprinklers, microirrigation, and bubblers. MWELO requires emission devices to adhere to the ASABE/ICC 802-2014 “Landscape Irrigation Sprinkler and Emitter Standard.”

Depending on the type of emission device the efficiency and flow rates vary.

H4/1.0 Sprinklers

The ASABE/ICC standard calls all overhead irrigation sprinklers. Spray irrigation are what the public generally calls “sprinklers” that pop-up or are stationary and found in single-family homes and other small landscapes. Rotors are the devices that are typically found in sports fields, parks and larger estates or properties.

Sprinkler: Spray irrigation device that emits water through a nozzle in various radii (spray distance 2 to 30 feet) and arcs (90 to 360 degrees). Sprinklers can be plastic or brass.

The flow rate for a sprinkler is measured in gallons per minute (GPM) and varies by make and model.

Sprinklers should not be used on the same irrigation zone as drip or bubblers.

PLACEHOLDER Photo 63 Spray Watering Yard

PLACEHOLDER Graphic 18 Spray Legend Symbol

PLACEHOLDER Photo 64 Rotor Watering Sports Field

PLACEHOLDER Graphic 19 Rotor Legend Symbol

H5/1.0 Spray Sprinklers

Anatomy of a Spray Body:

PLACEHOLDER Photo 65 Spray Body

Fixed Spray Nozzle– Less water-efficient as it can emit more water than the soil can easily absorb; emits a finer spray of water; prone to wind drift; prone to evaporation loss. The optimum pressure for these sprinklers is typically 30 PSI.

Rotary Nozzle – More water-efficient; emits larger droplets of water; less prone to wind drift; emits water at rate that most soils can easily absorb; can be adjusted to keep water in the within the designated area (on the lawn not the sidewalk). The optimum pressure for these sprinklers is typically 40 PSI. These are also called multi-stream, multi-trajectory nozzles.

Check Valve (optional) – “Stop-a-matic” device inside the sprinkler body at the inlet (bottom) that seals off water when the cycle ends and prevents low head drainage or water seeping out of sprinklers at lower elevation. These devices save water and prevent wet spots that can attract mosquitos and cause slipperyareas.

Pressure Regulation– A device inside the sprinkler body that regulates pressure to meet manufacturer’s recommendation. It is dependent on a certain flow rate to operate. Using the correct pressure saves water.

Pressure Compensation – A device in the nozzle that consistently emits water at the pre-set flow rate, regardless of pressure changes. It is not the same as pressure regulation.

Shut-off Valve – These may also be called sprinkler check-valves, but these devices installed at the inlet stop water flow by closing the valve when high flow due to a broken head/body and significant change in pressure occurs.

Swing Joint – Connects the sprinkler body to the lateral pipe and is movable which can help adjust sprinklers to the proper height and position and prevent risers from breaking when kicked, mowed, or run-over.

Riser – Vertical pipe that connects the sprinkler body to the lateral pipe.

Overlap or head-to-head coverage is necessary for uniform water coverage or dry spots will occur. Spray sprinklers need to be spaced closer together in windy areas to achieve even coverage.

PLACEHOLDER Photo 66 Sprinkler Head to Head Coverage

Spray sprinklers have either a fixed spray pattern or rotating pattern.

PLACEHOLDER Photo 67 Sprinkler Fixed Spray Pattern

PLACEHOLDER Photo 68 Sprinkler Rotating Pattern

Spray sprinklers can either pop-up (2 to 20 inches) or be installed on a riser at a specific height. Plant height at maturity should determine the height of the sprinklers in order to avoid obstruction of the spray.

Sprinklers are typically used for lawn/turf and groundcovers in smaller landscape areas at homes and commercial projects.

Sprinklers may need pressure regulation depending on the static pressure of the main water supply. Misting and hissing are an indicator that the pressure is too high.

PLACEHOLDER Photo 69 Sprinkler Misting

If using non-potable water, color requirements may be required for the sprinklers and piping. Check state and local codes.

PLACEHOLDER Photo 70 Sprinkler Recycled Water Purple

H5/1.1 Rotors

Rotors: Sprinkler irrigation for large lawn/turf areas that may require higher pressure and flow rates but apply water efficiently.

Gear Drive Rotor – Distributes water in a single-stream or multi-stream arc (40 to 360 degrees) over larger areas (13 to 50 feet) of lawn/turf. Found in larger yards and commercial landscapes. Typically made of plastic.

PLACEHOLDER Photo 71 Gear Drive Rotor in Yard

Impact Rotors – Distribute water in an arc (40 to 36 degrees) with a moving arm over a very large area (20 to 150 feet) and typically installed in large commercial lawn/turf areas. They are typically made of bronze or brass and need higher pressure.

PLACEHOLDER Photo 72 Impact Rotor Watering Field

H4/1.1 Microirrigation

The ANSI/ASABE/ICC 802-2014 standard considers microirrigation low volume and includes drip and microspray. The flow rate is less than 30 gph (0.5 gpm) at 30 psi.

H5/1.0 Drip

Drip irrigation delivers water to the plant's root area through a tube or small opening and is considered more efficient than sprinklers. There are three types of drip irrigation:

Dripline (Inline) – A tube that discharges water from evenly spaced, built-in emission points. This is also called "inline drip" and "line-source drip."

PLACEHOLDER Photo 73 Dripline

Multiple Outlet – Multiple emission points stem from one central component.

PLACEHOLDER Photo 74 Multiple Outlet Drip

Point-source – An emitter that discharges from a single point. This emitter is installed in a tube.

PLACEHOLDER Photo 75 Point Source Drip

Drip is typically used to water shrubs, trees, individual plants (not from flats), edibles but some models can be installed below the ground (sub-surface) to water lawn and other plants, e.g. parkways or bioswales. All drip should be buried under at least 3 inches of mulch.

Drip irrigation is measured in gallons per hour (GPH) at rates of 0.4, 0.6, 0.9, 1.0. A low-flow control valve is often needed for proper function at these very low flow rates. When a sprinkler valve (higher flow valve) is used for a drip system, the system turns on, but **it may not turn off**. This is because the flow is so low it doesn't register that any water is flowing. This happens frequently and can easily double or triple a water bill.

Drip operates at low pressure (15, 25, 30 or 40 PSI) and may need pressure regulation depending on the system pressure.

Drip should not be used on the same irrigation zone as sprinklers and/or micropsray.

Drip can be installed in a grid or draped around the root ball of plants.

PLACEHOLDER Photo 76 Drip Grid

PLACEHOLDER Photo 77 Drip Draped

If using non-potable water, specific colors may be required for the drip and piping. Check state and local codes.

PLACEHOLDER Photo Drip Recycled Water Purple

Anatomy of A Dripline System:

Control Zone Kit – A set of components for drip systems.

PLACEHOLDER Photo 78 Drip Control Zone Kit

*Low Flow Valve – A valve designed for very low flows.

*Filter – A fine, mesh screen that collects tiny debris and prevents it from entering the tubing and clogging it.

*Pressure Regulator – A device that regulates the pressure within the entire drip tube.

*Combination Filter and Pressure Regulator – Some manufacturers combine the filter and pressure regulator into one component.

Tubing/Pipes – Drip tubing is made of polyethylene (poly) or flexible polyvinyl chloride (PVC) and comes in different thickness (16, 17, 18, 24 mm); different diameter sizes (1/4, ½, 3/4 inch); and different flow rates. Manufacturers have a maximum length based on pressure, emitter spacing, and flow rate.

Dripline – Also called "inline" emitters are built into the tubing at 6, 12, 18, and 24 inch spacing; typically has debris removal capabilities inside the emitter to prevent clogging; some brands can be installed sub-surface. Many brands have built-in check valves to eliminate low head drainage. Some brands have pressure compensating emitters.

Point-source Emitters – inserted into the tubing manually with a special tool; prone to breaks and popping-off; can affect precipitation rate calculation with uneven spacing; pressure compensating emitters are available to deliver water at the specific flow rate at varying pressure; used where plants are spaced very far apart.

Multiple Outlet – "Spaghetti," "Feeder," "Distribution Tubing" is small ¼ inch tubes that branch off the main tubing; prone to cuts, breaks, and being pulled off.

Drip Fittings – Barbs or compression tees are used to connect the pieces and pipes together. Standard fittings are 16 mm and 17 mm.

Stakes – U-pins that hold the tubing in place.

Flush Valve –"End Cap," "Figure 8" or "Ball Valve"– A device at the end of the drip tube that closes it. It should be easily removed for proper maintenance and flushing the line.

PLACEHOLDER Photo 79 Drip Figure 8

Tattle-tale (optional) – A spray sprinkler with a white or brightly colored cap or stem that pop-ups when the drip system is turned-on as a way to show the system is pressurized and operating.

H5/1.1 Microspray

Mircropspray – A device with one or more orfices that converts irrigation water pressure to discharge water with a flow rate not to exceed 30 gallons per hour at 30 psi. It's also called "microbubblers," "microspinners," and "microspray jets." These are commonly used in flower beds, shrub beds, pots, and planters. These do not have matched precipitation. **To-date no**

manufacturer offers microspray that complies with MWELO and ASABE/ICC 902-2014.

PLACEHOLDER Photo 80 Microspray

H4/1.2 Bubblers

Bubblers: Small pipe or tube that emits water as a stream to flood the soil at a flow rate greater than 6.3 gph according the ASABE/ICC 802-2014 Standard. Bubblers are used to water shrubs and trees. Some tree bubbler systems are buried underground. There are three main types: adjustable flow, fixed flow, and micro bubblers. Some manufacturers make bubbler nozzles that fit pop-up sprinkler bodies. Bubblers should not be on the same valve as drip, sprinklers, and rotors.

Bubblers have a flow rate from 0.5 GPH to 35 GPH. Most exceed the flow rate allowed by MWELO.

If using non-potable water, color requirements may be required for the sprinklers and piping. Check state and local codes.

Adjustable Bubblers – can be manually adjusted to change flow rate.

PLACEHOLDER Photo 81 Bubbler Adjustable

Fixed Bubblers – are non-adjustable and the flow rate is fixed.

Stream Bubblers –have a narrow stream of water that sprays away from the bubbler from 2 to 5 feet.

PLACEHOLDER Photo 82 Bubbler Stream

H2/1.3 Water Features

Water Features: Design elements where water that is artificially applied performs an aesthetic or recreational function including ponds, lakes, waterfalls, fountains, artificial streams, spas, swimming pools. This doesn’t include constructed wetlands for wastewater treatment.

PLACEHOLDER Photo 90 Pool

To comply with the MWELO Performance Pathway, the surface area of the water feature is used to calculate the water demand as part of the overall landscape water budget and is considered a high water use or high Plant Factor of 1.0.

There may be additional regulations for water features such as pool covers for pools and spas. Check state and local regulations.

H2/1.4 Stormwater

Landscape designs must meet additional requirements set forth by the Regional Water Quality Control Board. Managing stormwater on-site takes advantage of limited water supplies, minimizes runoff, increases filtration to recharge groundwater, and improves water quality. To achieve these benefits, impervious hardscapes can be minimized and graded to flow into landscapes areas; permeable hardscapes can be installed; and a variety of elements and plantings installed such as drywells, rain barrels, cisterns, rain gardens. swales, basins, in addition to constructed wetlands.

Rain Garden: A depression with plants where rainwater flows from roofs, driveways, walkways, and surrounding landscape and is absorbed into the soil.

PLACEHOLDER Photo 83 Rain Garden

Rock Garden: A shallow depression, sparsely planted, and filled with gravel where rainwater flows and slowly seeps into the soil.

PLACEHOLDER Photo 84 Rock Garden

Swales: A shallow depression with gently sloped sides (at a minimum 2% grade) and native plants and mulch planted along the sides and bottom.

PLACEHOLDER Photo 85 Swales

Dry River/Creek Beds: A shallow swale designed to slow and infiltrate heavy rainfall that includes larger stones.

PLACEHOLDER Photo 86 Dry River Bed

Rain Barrels & Cisterns: Containers that collects rain from the roof downspout and used for irrigation. Rain barrels are smaller and hold up to 200 gallons. Cisterns hold more than 200 gallons. Rain barrels and cisterns must be screened to keep out mosquitoes.

PLACEHOLDER Photo 87 Rain Barrel

PLACEHOLDER Photo 88 Cistern

Resources:

Some irrigation manufactures have provided a list of MWELO compliant devices. DWR does not endorse nor recommend any products, materials, or services. These lists are for informational purposes only.

*Hunter - https://www.hunterindustries.com/sites/default/files/california_mwelo_lit-682_dom.pdf

*HydroRain - https://www.hydrorain.com/

*Orbit - https://www.orbitonline.com/

*Rain Bird - https://www.rainbird.com/agency/mwelo

*TORO – contact TORO for PDF file.H2/1.5 Calculating the MWELO Water Budget

The Performance Pathway requires an annual water budget which calculates the total water required for the established landscape which cannot exceed the maximum allowance.

H3/1.0 Key Terms

Reference ET (ETo) –The amount of water in inches per year needed to keep cool season grass thriving based on the evapotranspiration which water transpired by plants and evaporated from soil. Appendix A in MWELO provides a list of ETo for cities in every county and can also be found at www.cimis.water.ca.gov for each CIMIS weather station throughout California. You can get a free password from DWR to access weather and climate data.

Plant Factor (PF) –A number from 0 to 1.0 that was multiplied by a factor and ETo to estimate the water needed by plants. The water budget for residential landscapes allows for approximately 25% of the area to be planted with high water-use plants, such as turfgrass lawns.
MWELO defines the PF categories as follows:
- 0 to 0.1 = Very low water use plants
- 0.1 to 0.3 = Low water use plants
- 0.4 to 0.6 = Moderate water use plants
- 0.7 to 1.0 = High water use plants

Water Use Classification of Landscape Species (WUCOLS) –An online searchable database for Plant Factors of individual plant species and is published by the University of California Cooperative Extension and the California Department of Water Resources.
https://ucanr.edu/sites/WUCOLS/

Special Landscape Area (SLA) –Used for active recreation, places to gather, edible plants, and areas and water features using recycled water. The PF is 1.0. Special Landscape Areas are limited for single-family homes. Single-family homes **cannot** have recreational areas **but can** have Special

Landscape Areas for edible plants, areas irrigated with recycled water, and water features that use recycled water.

Hydrozones - Sections of the landscape where plants with similar water use needs are grouped together into irrigation zones served by separate control valves. Hydrozones may be irrigated or non-irrigated. Plants with high and low water PF are not allowed in the same hydrozone. Water feature surface areas are high water use hydrozones. Temporary irrigation is a low water use hydrozone. The hydrozone table displays this information concisely for efficient plan review and irrigation controller programming by the installer. The table below shows different Plant Factors depending on certain landscape elements and irrigation.

Table 1. Plant Factors for Landscape and Irrigation
PLACEHOLDER Table 1 Plant Factor for Landscape

Irrigation Efficiency (**IE)** –The percent of irrigation water taken up by plants and the total water applied. Irrigation water that is not used by the plant is lost through overspray, evaporation, and/or runoff. Even though MWELO sets the IE, the site conditions, like wind and topography, may lower the actual IE.

IE for MWELO is:
*0.75 for overhead spray irrigation (sprinklers)
*0.81 for drip irrigation

Evapotranspiration Adjustment Factor (**ETAF)** –The assignment of the plants' water needs and irrigation efficiency.
ETAF = PF/IE. Like plant factors, ETAF ranges from 0 to 1.0. MWELO drives efficiency by setting the ETAF at:
*0.45 Non-residential
*0.55 Residential
*1.0 SLA

Effective Precipitation (EPPT) –Twenty-five percent of the annual rainfall for the area. This can be used to calculate the maximum water allowance Incorporating EPPT into the water budget is optional.

Maximum Applied Water Allowance (MAWA) –Maximum water allocated to the landscape each year. It is calculated using the size of the landscape (LA and SLA), Reference Evapotranspiration (ETo), Evapotranspiration Adjustment Factor (ETAF) and a conversion factor from inches to gallons. The formula is:

$$MAWA = (ETo) \times (0.62) \times [(ETAF \times LA) + ((1 - ETAF) \times SLA)]$$

MAWA with Effective Precipitation for Residential Areas:

$$MAWA = (ETo-EPPT) \times (0.62) \times [(0.55 \times LA) + (0.45 \times SLA)]$$

MAWA with Effective Precipitation for Non-Residential Areas:

$$MAWA = (ETo-EPPT) \times (0.62) \times [(0.45 \times LA) + (0.55 \times SLA)]$$

Estimated Total Water Use (**ETWU**) –The total water used in the landscape per year. The formula is based on Reference Evapotranspiration (ETo), the Landscape Area (LA), the Plant Factors (PF), Irrigation Efficiency (IE) and a conversion factor from inches to gallons. The ETWU is calculated for each hydrozone and then added together. The ETWU must be less than the MAWA. The formula is:

$$ETWU = (ETo) \times (0.62) \times [(SF*PF/IE) \times LA]$$

H3/1.1 Water Budget Examples

Example 1: Residential No Special Landscape Project in Santa Monica, CA

$$MAWA = (ETo) \times (0.62) \times [(ETAF \times LA) + ((1 - ETAF) \times SLA)]$$

MAWA - Maximum Applied Water Allowance (gallons per year)
ETo=Reference Evapotranspiration of 44.2 For City of Santa Monica (annual Eto in inches per year)
0.62 = Conversion factor (to gallons)
0.55 = ET Adjustment Factor for residential projects (ETAF)
LA = Landscape Area 2,600 square feet for this project
SLA = Special Landscape Area: 0 square feet for this project

MAWA = (44.2 inches) (0.62) x [(0.55 x 2,600) + ((1-0.55) x 0)]
MAWA = 39,188 gallons per year

ETWU = (ETo)(0.62)((SF x PF/IE)+SLA)

ETWU = Estimated Total Water Use (gallons per year) and must be less than MAWA
ETo=Reference Evapotranspiration of 44.2 For City of Santa Monica (annual Eto in inches per year)
0.62 = Conversion factor (to gallons)

PF = Plant Factor from WUCOLS
SF = Hydrozone Area 2,600 square feet
IE = Irrigation Efficiency 0.75 for sprinklers and 0.81 for drip
SLA = Special Landscape Area: 0 square feet for this project

Table 1. Example 1 Hydrozone Table

PLACEHOLDER Table 1 Example 1 Hydrozone Table

ETWU = (44.2)(0.62)(1,173)+0
ETWU = 32,148
ETWU < MAWA = in compliance

Example 2: Residential Pool Project with No Landscaping in Chico, CA

MAWA = (ETo) × (0.62) × [(ETAF × LA) + ((1 - ETAF) × SLA)]

MAWA - Maximum Applied Water Allowance (gallons per year)
ETo=Reference Evapotranspiration of 51.7 For City of Chico (annual Eto in inches per year)
0.62 = Conversion factor (to gallons)
0.55 = ET Adjustment Factor for residential projects (ETAF)
LA = Landscape Area 520 square feet (pool surface area)
SLA = Special Landscape Area: 0 square feet for this project

MAWA = (51.7 inches) (0.62) x [(0.55 x 520) + ((1-0.55) x 0)]
MAWA = 9,167 gallons per year

ETWU = (ETo)(0.62)((SF x PF/IE)+SLA)

ETWU = Estimated Total Water Use (gallons per year) and must be less than MAWA
ETo=Reference Evapotranspiration of 51.7 For City of Chico (annual Eto in inches per year)
0.62 = Conversion factor (to gallons)
PF = Plant Factor 0.7 because pools are high water use but do require covers
SF = Hydrozone Area 520 square feet
IE = Irrigation Efficiency 1.0 for pools
SLA = Special Landscape Area: 0 square feet for this project

Table 2. Example 2 Hydrozone Table

PLACEHOLDER Table 2 Example 2 Hydrozone Table

ETWU = (51.7)(0.62)(364)
ETWU = 11,668
ETWU > MAWA = not in compliance

Example 3: New Neighborhood Development to be Completed in 3 Phases

MAWA = (ETo) × (0.62) × [(ETAF × LA) + ((1 - ETAF) × SLA)]

MAWA - Maximum Applied Water Allowance (gallons per year)
ETo=Reference Evapotranspiration of 57.3 For City of Patterson (annual Eto in inches per year)
0.62 = Conversion factor (to gallons)
0.55 = ET Adjustment Factor for residential projects (ETAF)
LA = Landscape Area is Total Landscape (including SLA) 227,584 square feet (landscaping and pool)
Phase 1: 50 single-family homes - landscaping front yards only totaling 26,000 sq.ft. plus street medians totaling 6,000 sq.ft.
Phase 2: 25 townhomes - landscaping front yards only totaling 8,500 sq.ft.
Phase 3: dog park, park areas with shrubs, trees, streetscaping totaling 93,142 sq.ft.
SLA = Special Landscape Area: (square feet) of 93,942 square feet for this project
Phase 2: Pool totaling 800 sq.ft.
Phase 3: Clubhouse and park area with turf totaling 93,142 sq.ft.
Total Landscape Area = 227,584
MAWA = (57.3) (0.62) x [(0.45 x 227,584) + ((1-0.45) x 93,942)]
MAWA = 5,473,878 gallons per year

ETWU = (ETo)(0.62)((SF x PF/IE)+SLA)
ETWU = Estimated Total Water Use (gallons per year) and must be less than MAWA
ETo=Reference Evapotranspiration of 57.3 For City of Patterson (annual Eto in inches per year)
0.62 = Conversion factor (to gallons)
PF = Plant Factor from WUCOLS and 1.0 for pool
SF = Hydrozone Area (square feet)

IE = Irrigation Efficiency 0.75 for sprinklers and 0.81 for drip and 1.0 for pool
SLA = Special Landscape Area: of 174,240 square feet for this project

Table 3. Example 3 Hydraonze Table

Table 4. Example Special Landscape Table

ETWU = (57.3)(0.62)(35,220+93,942)
ETWU = 4,588,609
ETWU < MAWA = in compliance

Example 3A: New Neighborhood Development to be Completed in 3 Phases Using Effective Precipitation

MAWA Using EPPT = (ETo-EPPT)*(0.62)× [(ETAF × LA) + ((1 - ETAF) × SLA)]

Annual Precipitation = 15 inches in Patterson, CA
EPPT = 25% of 15 inches or 3.75 inch/year

MAWA with EPPT = (57.3-3.75)*(0.62) x [(0.45 x 227,584) + ((1-0.45) x 93,942)]
MAWA With EPPT = 5,115,640
ETWU < MAWA = in compliance