Rain Garden Care

HANDBOOK

backyards
neighborhoods
commercial

Watershed Management Group

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This handbook was written and edited by Watershed Management Group (WMG) with graphic design by Dennis Caldwell. Photos are from WMG and Julius Schlosburg.

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Streetside basin with curb cut collects stormwater off the street at the Ward 6 Council Office in Tucson. Native bunch grasses in the basin protect the soil and help quickly infiltrate water. Regular maintenance needs at this site includes removing invasive weeds, keeping plant growth away from the sidewalk, and occasionally removing sediment that has built up in the sediment trap adjacent to the curb cut.

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Introduction

Desert rain gardens do more than just harvest rain - they are living, ecological systems that improve the health of our urban environment. Rain gardens reduce flooding, irrigate trees, process stormwater pollutants, create wildlife habitat, shade and cool streets and buildings, slow traffic, and beautify neighborhoods. Constructed landscapes that use living, natural systems to provide environmental services like these are also called green infrastructure (GI).

Care vs. Maintenance

In this guide, we show how desert rain gardens are living systems that require a different care approach. This approach differs from your typical "mow, blow, and go" landscape maintenance practices, which manage landscapes as spaces that need to be cleaned instead of as gardens that need to be nurtured. To simply "maintain" a landscape is to keep it in a static state that only degrades over time. To "care" for a landscape, on the other hand, is to foster the development of a dynamic, living system that can provide and improve over time. We use the term "care" to reflect the need to shift our landscaping paradigm towards one that is more in tune with natural processes - especially in urban and desert environments like ours.

Seasonal Care Practices

In the desert southwest, and especially in the Sonoran Desert bioregion, rain garden care practices are best organized and applied according to our five seasons. These include spring, dry-summer (or pre-monsoon), wet-summer (or monsoon), fall, and winter. Late summer monsoon rains bring distinct changes and care needs, calling for an extra season. It is important to note that climate change is already affecting our seasonal patterns and will continue to do so for the foreseeable future.

Rain Gardens Designed to Mimic Nature

This handbook is for rain gardens that have been designed with locally-appropriate native plants, including a mix of trees, shrubs, and bunch grasses, that can be sustained solely by rainfall and stormwater. If your rain garden does not meet this description, consider shifting your plant palette over time to feature more native plants and reduce reliance on additional, ongoing irrigation (see pages 10-11).

When left in place, leaves and mesquite pods "littering" the ground will break down and provide essential nutrients to the soil. If you're concerned about plant litter looking "messy," you can rake the plant litter from pathways into the basins or mulched areas of your landscape.

When seasonal plants like wildflowers die back, the dry plants can be incorporated into the mulch and wildflower seeds can be collected and spread to new areas.

Rain Garden Ecology

Rain gardens contain living organisms, including animals, plants, and microbes, all interacting with one another and the landscape. Like all living things, rain gardens change and mature, requiring nurturing to establish and thrive. So, let's start with understanding the rain garden ecosystem's three primary components:

1. Soil
2. Plants
3. Water

Building Soil

Healthy soil is the foundation of a prosperous ecosystem. But soil comprises far more than just the dirt you find stuck to your shoes. In fact, soil is an active mixture of minerals and organic components (derived from living matter). Indeed, the soil is literally alive! A soil rich in organic material can efficiently store the moisture plants need and host fungi and microbes that provide nutrients to plants and break down many environmental pollutants. Urban desert soil is often sterile, dry, and compacted. Fret not! A few simple steps can bring this soil to life.

Building Organics

Desert soils, especially in urban areas, are generally low in organics. When we blow or rake away leaf litter, we deprive the soil of the essential nutrients and moisture-holding capacity that plants depend on. So, while conventional landscape maintenance involves raking, bagging, and sending plant litter to the landfill, reusing this organic material on-site as mulch helps enrich and protect the soil allowing for healthier and more resilient plant life.

Maximizing Plant Benefits

A rain garden doesn't work without plants—they are essential to turning your soil into a living sponge. Plant tissues absorb water, while their root systems create pathways for the water to infiltrate deep into the soil, thus keeping it from ponding in basins, where it will only evaporate or breed mosquitos. Plants in desert rain gardens play various other roles as well, providing ecological benefits such as:

- Producing food for people and critters
- Attracting birds, butterflies, bats, bees, and other pollinators
- Adding nutrients in the soil by building organic matter
- Un-compacting soil through root growth and adding organics
- Protecting the soil surface and preventing erosion

Growing Natives

A native plant or animal is one that has existed and evolved in the place where it lives for thousands of years. In addition to thriving on rainfall alone, native plants play an essential role by creating a functional and diverse ecosystem in the desert, with abundant habitat and food for all our native wildlife, big and small. Lastly, native plants support a sense of place unique to your community, cultivating a connection to your surrounding environment.

Minimizing Non-Native Plants

Our urban communities have introduced to the native landscape a wide variety of introduced plants from other regions, sometimes called exotic or non-native plant species. Many of these plants are "desert adapted," which means they can grow in our desert climate but often require additional irrigation and cannot survive on seasonal rainfall. Non-native plants also reduce benefits to wildlife; native wildlife prefers native plants for habitat and food. Non-native plants can also be less resilient to drought and extreme heat. For all these reasons, we recommend using native plants in rain gardens.

Understanding Drought-Deciduous Plants

Many Sonoran desert plants are drought deciduous—plants that shed their leaves during periods of drought, generally during our dry seasons. This phenomenon is a natural adaptation to survive in a variable desert climate. It is important to understand that desert plants lose leaves during drought, just as plants in northern climates do in winter, and that leafless plants are not dead but will quickly green up upon the arrival of seasonal rains. This may require the education of groundskeepers and landscapers to ensure native plants aren't assumed dead and removed during their dormancy period.

Planting for Pollinators

Wildflowers and other native, flowering shrubs provide critical habitat for pollinators, including birds, bats, bees, and other insects. Pollinators spread reproductive cells from one plant to another, enabling food production and keeping our desert ecosystem biologically (genetically) diverse, healthy and resilient. Consider incorporating a range of native flowering plants that can provide pollinators food resources through different seasons.

Ocotillo is a drought-deciduous plant. Often called the desert barometer, it responds quickly to water availability, rapidly shedding and growing new leaves accordingly.

Pink penstemon and orange globe mallow are native annuals that add color and life to your rain garden.

Planning for Seasonal Rainfall

In Tucson, Arizona, we live in a region of the Sonoran desert that receives, on average, around 11 inches of rainfall per year. The majority of this rainfall occurs during two periods each year—the winter and summer rainy seasons—forcing native desert dwellers to adapt to long, dry periods without rain. A well-planned rain garden is adapted to these cycles and can maximize limited rainfall to support its native plants and wildlife year-round.

Cleaning Stormwater Through Bioremediation

Trash, petrochemicals from cars, pet waste, and other surface contaminants from our streets, parking lots, and yards get picked up by stormwater and pollute our soil, streams, and rivers. There is good news—the microorganism communities that naturally form in the soil and among the roots of rain gardens act as a filter, cleansing stormwater and effectively breaking down a wide range of pollutants into nutrients that can then be absorbed by plants. Rain gardens are an effective way we can keep pollutants out of our groundwater, creeks, and rivers!

This basin harvests stormwater running off from the street—pollutants such as petrochemicals from cars are then broken down by microorganisms in the soil and made available as nutrients to plants, like these native grasses.

Styrofoam cups, plastic bottles, and lots of other trash and pollutants are carried into the Rillito River in Tucson when rainstorms move this trash from our streets, alleys, and properties.

This streetside basin in Avondale, AZ, traps trash and other pollutants, preventing them from moving into a nearby wash or creek.

Rain Gardens Conserve Water!

Rain gardens provide substantial water conservation savings by relying on renewable rainwater supplies instead of on municipal or groundwater for irrigation. Not only do rain gardens reduce or altogether eliminate the need for pumped groundwater to irrigate, they often help replenish our aquifers by enabling stormwater to soak-in near where it fell, recharging many of the shallow aquifers that support our region's precious creeks and rivers.

In Arizona, the largest use of potable water is for landscaping, ranging from 30% up to 70% of residential water use outdoors. By creating an effective rain garden and shifting to native plants that are rain-fed and adapted to low-water-use, you can totally eliminate the need for supplemental irrigation. What is more, household "greywater," like laundry, shower, and sink water, is perfectly suitable for use in your residential, rain garden-supported landscape. For example, if you have fruit trees, some of which have high water demands, incorporated into your rain garden, greywater can be made available to supply the additional irrigation needed.

Tip: Prickly pear, agave, and other cactus planted near basins need minimal water to get established, just in the first year, until the next rainy season. Regular irrigation may kill cactus.

Sink greywater is redirected to flow into a basin with a thirsty fig tree. This basin is also fed by a laundry-to-landscape system, which diverts greywater from the washing machine through distribution tubing to the landscape.

Irrigation

Rain gardens can be designed to thrive solely on rainwater and stormwater, however, when rain gardens are first built, they will likely need 1-3 years of supplemental irrigation to ensure the plants get established. To avoid installing costly and wasteful irrigation systems, consider a temporary irrigation system, such as hand-watering or if along a street using a truck water hauler. You can also leverage the seasons by establishing plants from seed and syncing their growth with the rainy seasons—minimizing or eliminating the need for supplemental irrigation.

IRRIGATION GUIDE FOR RAIN GARDEN PLANT ESTABLISHMENT

1st Year:

Nurture them now for stronger plants later.

- Water deeply right after you plant, then every 1 - 2 days for the first two weeks
- Then water based on the season:
  - **Dry summer:** water 2 times per week
  - **Wet summer:** water as needed (1 - 2 times per week) based on available rainfall
  - **Fall, winter, and spring:** water every 1 - 2 weeks depending on rainfall during the winter season

2nd Year:

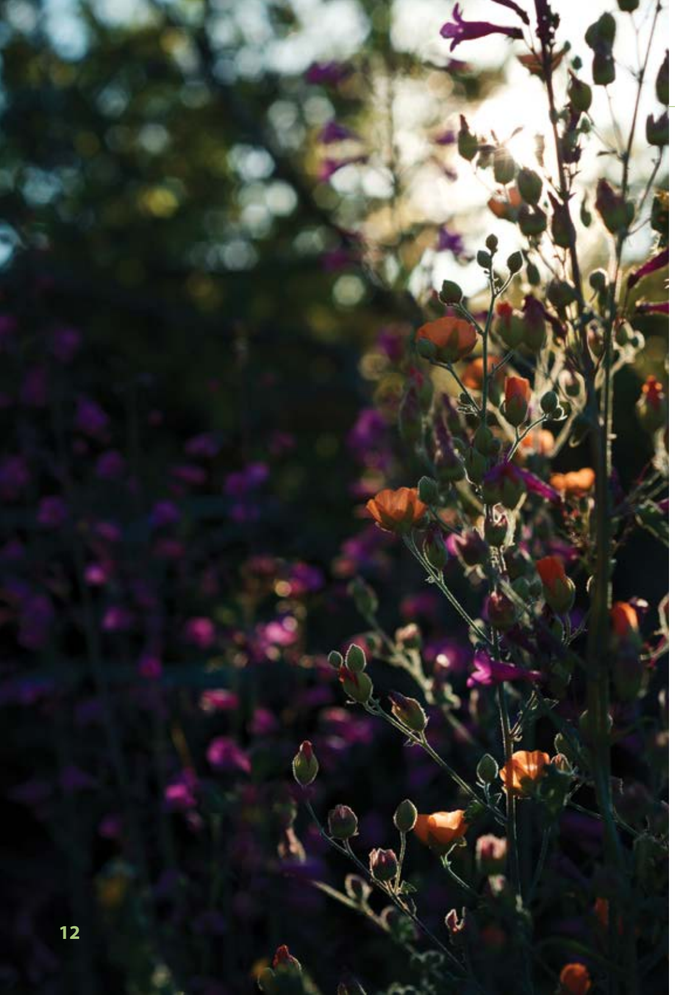
Begin to wean your plants off supplementary irrigation.

- Dry summer: water one time per week
- Wet summer: water as needed (no more than 1 time per week) based on available rainfall
- Fall, winter, and spring: water 1 - 2 times per month

3rd Year and beyond:

Let the rain do the work!

- Water monthly (only if needed) during dry summer months or times of drought



Spring

(March-April): warm, blooming, and active!

With gentle rains in January through February and warming temperatures by March, you'll see new growth in your rain garden. Spring is a great time to make tweaks to your garden's structure and tend to your plants. Temperate weather, wildflower blooms, new foliage, and bountiful food for wildlife make spring an exciting time. Make time to enjoy the fruits of winter's labor!

SEASONAL HIGHLIGHTS

Watch as globe mallow, penstemon, brittlebush, Mormon tea, and desert lavender bloom first, followed by early bloomers in the Opuntia family (cholla and prickly pear cacti), leguminous trees (mesquite and palo verde), and the giant saguaro! Migratory songbirds may grace your rain garden, along with many species of ground-dwelling native bees.

WHAT TO LOOK FOR

New growth

- Monitor cold-dormant or cold-sensitive plants and look for budding. Wait until late spring (April) to prune frost-bitten branches and keep an eye out for lagging cold snaps.
- As establishing plant canopies enlarge with new growth, move emitters to irrigate along the outside edge of a plant's canopy (the "drip zone"). Watering at the base can cause root circling, which strangles plants.
- Address the emergence of weeds (see next section) early and before they set seed. London rocket is especially prevalent during this season.

Tip: As spring annuals flower and go to seed, you can collect seeds and spread them, enlarging the seed bank in your soil and sharing seeds with others.

BEST PRACTICES

Do's

Be proactive! You can easily remove most weeds following these steps:

- Remove weeds when they are small and soon after it rains. Weeds are easiest to pull when roots haven't grown too deep yet, and the soil is soft.
- Pull or dig out the entire weed, including the root system. Fingertips, a trowel, hoe, or shovel should be sufficient to do the job. If you just cut off the top, the plant will likely continue to re-sprout from the base.
- Remove weeds before they set seed! This will reduce weed seeds in the soil and reduce their abundance the following year.
- If weeds have not gone to seed, use the weeds as mulch in your basins!

Promote growth of desired native annual plants

- Annual plants seed, grow and die in a single season. They rely on seed banks—clusters of seeds underground that are waiting for conditions to be right for them to grow and reestablish plants each year. Plant native, annual plants or spread wildflower seed-mix to encourage your native annuals to establish and self-seed in your basins. Over time, your native annuals can outcompete invasive annual plants, reducing the time you need to spend pulling weeds over the long term.

Collect trash and pet waste

- Weed management during the rainy seasons should be paired with frequent trash removal. Trash can accumulate quickly with stormwater flows, so pay special attention to inlets and overflows. Green spaces attract pet owners, and you may find dog poop near your rain gardens. Small amounts of dog poop can be scooped and put under the mulch in basins to naturally biodegrade. If dog poop is a consistent problem, consider signage and/or a dog poop bag dispenser on location.

Don'ts

Don't use chemical herbicides and fertilizers

- Chemical pre-emergent and weed killer is sprayed frequently on public and commercial landscapes (often seen as blue/green coloring). These chemicals are harmful to our soil, water, and wildlife, and they can remain in biological systems and cycles for years.
- Chemical fertilizers are not necessary for native desert rain gardens. Natural mulch provided by fallen leaves and other deposited organic material breaks down to provide your plants all the nutrients they need. If your rain garden includes fruit trees, then choose compost and organic soil amendments to meet nutrient demands.

Remove weeds like bufflegrass in the springtime before their seed heads develop. It's important to remove invasive weeds from streetside rain gardens, so seeds don't spread to other areas in future rainstorms.

Community members can help care for green infrastructure by planning neighborhood clean-up days. Along with removing trash, volunteers can be trained to identify and remove invasive weeds.

TROUBLESHOOTING

What is a "weed"?

Weeds are generally undesirable plants that you don't want in your rain garden. However, in many cases, plants considered to be weeds are actually beneficial. WMG defines weeds more specifically as plants that are invasive or aggressive and will outcompete your desirable plants. Many of these invasive non-native weeds have dormant seed banks that respond to winter rains by developing rapidly come spring. These will be the highest priority for removal.

Note: Don't make the mistake of removing native bunch grasses, which look similar to buffelgrass, and are often used in rain gardens

Tip: If other non-grass plants are growing in your rain basin that you don't want to keep around, consider chopping them and dropping their non-seeding parts into the basin as organic mulch.

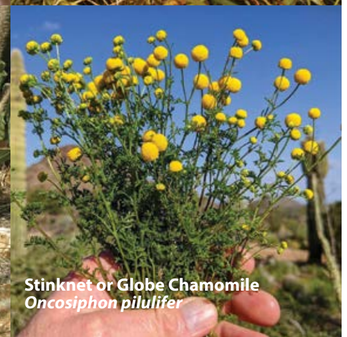
Giant Reed
Arundo donax

Goat's Head or Puncture Vine
Tribulus terrestris

Red brome Grass
Bromus rubens

Bufflegrass
Cenchrus ciliaris

Fountain Grass
Pennisetum setaceum



Stinknet or Globe Chamomile
Oncosiphon pilulifer

My basin is a bermuda triangle!

Basins full of bermuda grass become extremely time-intensive to weed and maintain. To prevent this common problem, make sure Bermuda grass, including the root and rhizome system, is entirely removed before you plant your rain garden. Stay on top of it with frequent weeding to remove new grass and root nodules as they pop up. Use layers of mulch to smother and prevent re-seeding.

The grass is blocking the inflow to the basin, preventing water from entering and choking out the native plants.

Gravel will not suppress bermuda grass and makes manual removal difficult. We recommend trying manual removal extensively before considering control with herbicides, which could harm your rain garden ecology.

Summer (Pre-Monsoon)

Dry Summer (May-June): hot, dry, dormant.
After a bountiful, pleasant spring can come a harsh, hot summer. Many plants, even natives, can struggle during this time of year until the monsoon comes. Temperatures are increasing due to the urban heat island effect and climate change; our role as caretakers is to monitor our plants closely during these months and adapt care as needed until relief comes with the summer rains.

SEASONAL HIGHLIGHTS

Animals may retreat to cooler areas such as mountains and riparian corridors. Look for animal activity near dusk, dawn, or nighttime. Many night-flowering, columnar cacti (organ pipe, senita, cereus) will bloom and be visited by nectar-feeding bats and moths. Saguaros will have ripening fruit ready to harvest between late May and early July. Some native plants like wolfberries will look dead, but they are actually in a drought-dormant state. Once the monsoon rains soak the soil deeply, they will quickly re-leaf.

WHAT TO LOOK FOR

Fruiting and seeding

- Springtime bloomers fruit and seed. Collect seed in your yard or out along the streets, and scatter it in your garden near the end of this season and just before the summer rains arrive.
- Saguaro fruit ripens in this season. Saguaros are protected from harvest on public lands, but you can seek out neighbors who may be willing to share the bounty in their front yards.
- Once they are brittle enough to break with your thumb and forefinger, mesquite pods can be harvested. See the Desert Harvesters website, **desertharvesters.org**, for more tips on harvesting mesquite for flour and chaff. It is recommended to harvest mesquite pods before the monsoon.

Heat stressed plants

- A non-drought deciduous species showing a loss or discoloration of foliage indicates heat stress.
- As annuals brown and die off, cut the tops off and mulch their remains into basins. This is called "dead-heading," and will need to be done with spring wildflowers.

Erosion

- Do a final check of inlets/outlets and inspect areas of existing or potential erosion. Now is the time to build strong structures before any big monsoon rains.

A small erosive feature is developing next to the tree where water naturally drains. Erosion can be caused by increased impermeable surfaces, lack of groundcover, or soil disturbance from animals or construction.

A newly installed one rock check dam is built as part of a neighborhood planting project. The one rock dam will help slow the flow and reduce erosion in the streetside swale.

BEST PRACTICES

Do's

- Save major pruning for fall; plants need their leaves and branches as sun protection.
- Add organic mulch; mulch helps insulate your soil from the heat and prevents soil moisture loss.
- Consider where extra shade is needed to reduce plant stress and plan to add extra native shade trees in the fall on the southwest side of the rain garden for long-term shade from afternoon sun.
- If supplemental water is needed, water early in the morning or later in the evening to reduce moisture loss due to evaporation.
- Practice ethical seed and fruit collecting (leave some for the birds and bees). Many plant species are protected on public lands, so focus on harvesting and sharing within your neighborhood.

Don'ts

- Don't plant in the heat of the moment. Summer is a time of heat stress and drought. This limits the likelihood of plant survivorship, so consider holding off on new planting until it cools down.
- Don't overwater your rain garden. Get to know what plants are drought deciduous and how native plants respond to the hot summer. Observe what native plants are doing in natural areas (without irrigation) as your guide. Some supplemental water will be needed if plants are still in their establishment phase, if there is an extended drought period, or if there is a late start to the monsoon. Otherwise, you can be confident that desert plants, adapted to the hot, dry summer months, will survive.

Organic mulch in basins helps keep the soil cool and reduces evaporation—helping plants be more resilient in hot summer months.

TROUBLESHOOTING

Why is my plant losing its leaves?

Many native plants are drought deciduous, which means they lose their leaves during drought to save water. Before you assume a plant is dead, look up the species to check. Your plant may be dormant!

Non-drought deciduous species exhibiting loss or discoloration of foliage during summer are likely suffering heat stress. When planting, make sure to choose the best place for that plant. For your plants to thrive, you must take into account water needs, microclimate, and sun exposure. If necessary, consider:

- Providing supplemental irrigation for newly-established perennials or during extremely dry, hot years when plants are visibly beginning to wilt, brown, lose leaves, or otherwise show stress. Water by hand, if possible, to reduce water waste.
- Building shade structures with shade cloth for sun-stressed plants. This should not be needed for most native plants, but extreme heat can be amplified in urban environments by pavement, reflected surfaces, and buildings, creating additional stress.

Regularly spaced shade trees planted in this streetside green infrastructure helps provide shade for pedestrians and cyclists. Native bunch grasses also help cool the landscape and retain soil moisture.

Monsoon

(July-September): hot, wet, and exciting!

This is the season that makes the Sonoran Desert famous! Our summer rainy season, also known as the North American Monsoon, is brought about by a shift in wind patterns coming from the South instead of from the West. These southerly winds bring moisture from the Pacific Ocean, Gulf of California (Sea of Cortez), and Gulf of Mexico to create frequent, intense, and short-lived thunderstorms. Half our annual rainfall comes during these three months, and life in the Sonoran Desert is adapted to this seasonal respite from the heat and drought.

SEASONAL HIGHLIGHTS

Monsoon rains bring a season of abundance to the desert. It is a time to sow "short-season" monsoon crops, such as the "Three Sisters" of corn, squash, and tepary beans, which were traditionally planted together. Make observations daily to keep up with the rapid and diverse plant and animal changes that occur as the desert comes to life. Watch the desert floor for busy bugs like harvester ants, millipedes, and tarantulas. Peer into puddles for signs of tadpoles or our Sonoran spadefoot toad, especially after the first soaking rain.

WHAT TO LOOK FOR

Rain!

- Make time to observe your rain garden when it's raining to better understand areas of overflow and erosion.
- Observe the differences between small rain events and large rain events. Notice patterns in soil saturation to better understand your basin's capacity and ability to support nearby plants. Are small rain events able to wet the soil near and around your plants? Are large rain event flows able to pass safely through without overwhelming your rain garden? Use these observations to get familiar with your system and stay on top of any maintenance needs.

Pruning

- Prune back new growth only as needed to maintain clear sight and access ways.
- Drought deciduous or dormant plants will begin budding. Wait for winter before pruning off "dead" branches. They may still be dormant.

Clogs and sediment

- Identify and remove inlet or outlet clogs.
- High flow events of the monsoon season can leave large amounts of sediment in your basin. Basins spread water causing it to slow down, which allows sediment to drop out. While sediment buildup is natural, sediment can decrease basin capacity, create clogs, and bury plants over time. Assess if it needs to be removed.
- Check basin structures for loose rockwork. Rebuild and repair as necessary.

Erosion

- Erosion from rains means you should check for loose or misplaced rocks and re-stabilize them. Remove mulch or other debris buildups in your basin inlets and overflows, which can keep critical water flows from getting in and out of your basins.

Do Rain Gardens Breed Mosquitoes?

Rain gardens are designed to quickly soak and infiltrate rainwater into the ground, so they will not breed mosquitos. It takes eight to ten days for a mosquito to go from egg to adult. Rain gardens can easily infiltrate large amounts of stormwater in just a few hours and should never have a problem infiltrating water within a maximum time of 24 hours. If standing water is noticed in a rain garden, you can add organic mulch and more plants, such as bunch grasses, within the basin to solve the problem.

This public rain garden along North Shannon Road in Tucson, AZ, harvests water from the street via "scuppers." The water is spread throughout the basins at an 8-inch ponding depth, allowing thousands of gallons of water to infiltrate the soil in less than 24 hours!

BEST PRACTICES

Do's

Long and thoughtful observation

- Observe and make incremental changes between storms. The rains are the best teacher. Set aside more time now to observe and tweak your system to help catch issues early.

Size up

- Climate patterns are shifting towards less frequent but more intense monsoon storms. Gutters, downspouts, inflow channels, outflows, and basin capacities should be scaled to handle high-flow events. When in doubt, oversize basins/plumbing to accommodate large flows.

Eat wild plants

- We love wild annuals that you can eat! One of our favorite examples of a weed becoming a nutritious prize is purslane, also known as verdolagas. It pops up freely in yards of the southwest during the monsoon season.
- And there's more - what's commonly referred to as pigweed is amaranth, the staple food of the Aztec Empire! You can quickly harvest, chop, and toss these into your favorite salad.

Don'ts

Don't create basins without mulch

- Rain gardens and other green infrastructure need mulch to protect soil, reduce erosion, and reduce evaporation. If you're creating basins during the rainy season, make sure to add organic mulch (or gravel mulch) right away to prevent erosion during rainstorms.

TROUBLESHOOTING

Why is water standing in my basin?

Lack of infiltration can be caused by a variety of issues including: heavy clay soil, caliche (hardpan), compaction of soil, accumulation of fine sediments that cause surface sealing, and lack of plants and soil organics.

When striving to increase your basin's infiltration rate, consider the following:

- Add organics and plants. Roots can help un-compact soil, break up surface sealing sediment, and soak up moisture.
- For clay soils, or if you have underlying caliche, decrease basin ponding depth and, if space allows, increase the width of your basin area to maintain capacity.

Purslane

Amaranth

Heavy clay soils prevented water from infiltrating in this basin – causing standing water and plant die-off. To fix this problem, the basin depth was decreased and new plants were placed along the waterline edge to help facilitate infiltration in a timely manner.

How do I tell where water is flowing?

Watching water flow during and after a substantial rain is the most surefire way to see its course. Water also leaves behind many traces. Look for debris lines, dense or weedy plant patches, soil moisture, sand ripples, surface scouring, and other key indicators of where your water has been directing water flows to the most desirable locations is essential to creating an effective rain garden. The best way to do this is to get out in the rain and see the flow in action!

- Check rock work for debris buildups to ensure your system doesn't get clogged.
- Debris deposited on roadways and flat surfaces leaves flow lines that indicate the flow of water. The curve of the debris line points opposite (upstream) to the direction that water is traveling.
- The size of debris can tell you volumes! Higher volume systems can move large debris, while lower flow/volume systems will move only smaller debris.

How do I spot erosion?

Erosion is a natural part of any water system, however, it can be especially problematic in urban systems where hard impermeable surfaces cause water to flow faster and at higher volumes. Flows such as those we receive during the monsoon can cause rapid erosion and damage to your rain garden. Monitoring the landscape during monsoon is important to prevent system failures, such as berm blow-outs and failed rock structures.

Common signs of erosion to look for:

- Sediment "fans" forming at the base of a rock structure, in basin bottoms, across sidewalks, or other flat surfaces.
- Misplaced/loose rocks. Hint: Poor rock placement can sometimes be hard to visually see – lightly kick or carefully walk across rock structures to check their looseness and stability.
- Gullies – small carved out "canyons" that form in the soil – are especially common along steep slopes.
- Headcuts – a nickpoint along a drainage where a vertical drop is present – can quickly migrate up channel.
- For more information on erosion control, check out the Field Guide to Riparian Restoration and Upland and Arroyo Erosion in WMG's online Resource Library.

To address erosion, consider the following:

- Regrade steep slopes. As a rule of thumb, slopes with a ratio greater than 3:1 should be reinforced with rockwork.
- Spread seed to help reinforce and protect bare slopes with plant material.
- Rebuild failing rock structures and build additional structures in locations where unwanted erosion may be occurring.
- Divert surface flows off of paths or roads frequently.

Is my basin too small?

If you find most rainwater overflows in a typical storm (0.5 - 1 inch rainfall), your basins may not be large enough. Consider expanding your basins by widening and/or deepening existing basins or adding additional basins if there is space.

With climate change, monsoon rain is falling at larger volumes, but less frequently, so you'll need to be prepared to capture these few, big rainfall events.

You can also increase the capacity of rainwater capture through rain tanks—we suggest sizing your tank(s) to capture a full rainy season or at least several large storms. Remember to route your tank overflow into your basins to maximize your benefits.

Fall

(September-November): warm, dry, vibrant.
In fall, temperatures cool off, making it a great time to get outside, assess, and address any issues after the monsoon season. It is important to monitor plant health throughout the fall and prepare your system for the cool season.

SEASONAL HIGHLIGHTS

Several monsoon-adapted plants fruit throughout the fall, including barrel cactus, hackberry, wolfberry, and mistletoe. Wintering birds rely heavily on these fruits. Many reptiles begin to burrow for the winter.

In late fall and winter, you can enjoy native foods fed by rainwater like barrel cactus fruit. Just twist the fruit to remove from the cactus.

WHAT TO LOOK FOR

New growth

- Monsoon rains bring a new round of seasonal weeds and native annuals. Remove unwanted plants before they go to seed. Chop and drop them into your basins.
- Observe the size of your tree and shrub canopies. If you're using drip irrigation to establish the plants, move the emitters out to the expanded canopy drip line.

Erosion from monsoon rains

- Check rock work for erosion from monsoon rains and repair. Non-rocked areas like swales and berms may also need to be regraded if you are observing erosion on their slopes.

Additional irrigation

- If there are well below-average monsoon rains, you may need to provide additional irrigation to plants during the fall to help them make it to the winter rainy season.

Deadheading

- Once native annuals and perennials have gone to seed, you can deadhead dried flower blooms. Chop and drop to re-use this organic material in the landscape! Deadhead flowers by pinching or pruning off dried flowers and seed heads just below the base of the pod or spent flower head. Sprinkle seeds into basins to build and support seed banks for native annuals.

Annual grasses and wildflowers dry up in the fall. In urban landscapes, these plants can be deadheaded or cut back and added as mulch to basins. Avoid disturbing the soil by pulling or raking the plants.

Fall is a great time to replenish rain gardens with additional plants and mulch before the winter rains start.

BEST PRACTICES

Do's

Add more mulch

- Add or replenish organic mulch if your rain garden hasn't built up enough of its own yet. Larger, woody mulch helps insulate your soil from the oncoming cooler nights and is especially good to place around trees.
- A mulch layer thickness of 2-4 inches is recommended in basins and 1-2 inches in upland areas. If the mulch is too thick in upland areas, then moisture from small rains will not reach the soil. Also, wildflower seeds will more easily germinate if your mulch layer is less than 2 inches thick.

Plant trees and shrubs

- Plant trees and other perennial shrubs and grasses in the fall - with cooler temps and the coming winter rains, plants have an easier time getting established with less supplemental irrigation.

Spread wildflower seeds

- Spread and rake spring annual wildflower seeds in and around your basins so they can germinate successfully with winter rains.

Clean out sediment traps

- After the monsoon season is over, check the inlets, outlets, and sediment traps of your basins. It's possible sediment or debris has built up, blocking water flows or reducing capacity. Remove debris from inlets and outlets and remove sediment from sediment traps as needed.

Don'ts

Don't prune trees

- Pruning in the fall is not recommended because the tree will have a difficult time healing while preparing to go dormant for the winter. Prune trees minimally, only out of necessity, for example if branches are blocking walkways. See Spring notes on pruning.

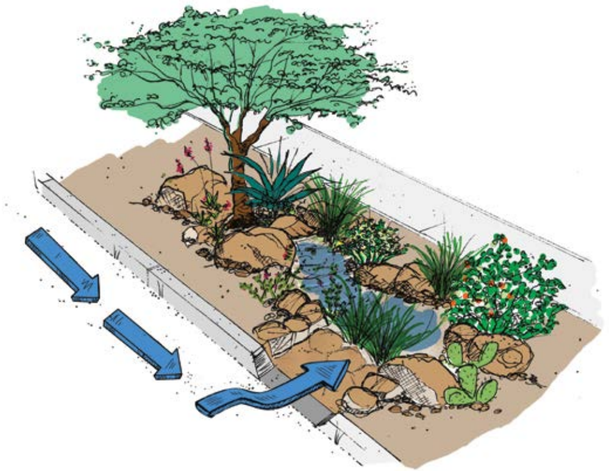
Watch for native tree seedlings

- Tree seedlings can naturally germinate in your yard as "volunteers." Once you've determined a seedling is a native tree in a desirable location, let the seedling grow on its own. This is a great way to increase the number of trees in your landscape with little effort (native trees that germinate naturally need no additional irrigation). Succession is a natural process wherein young trees grow and fill in the spaces where older trees have died. We often don't allow for succession in our yards, but it is just as crucial for creating shade and forming habitat corridors in urban settings as it is in natural ones.

TROUBLESHOOTING

Can my basins support more plants?

You may want to add plants to your rain garden for various reasons: to increase the infiltration capacity of a basin, to provide more shade, or to replace plants that have died over the years. When adding plants, consider the best place for the plant and if the basin will support the plant's water needs. Research what size your plants will be when mature, and ensure they will have enough space and sunlight to thrive. Plant trees on the edge of basins, where the base of the tree will not be submerged when the basin fills, but the roots can tap into the basin. Plant grasses and native shrubs in the basins. Plant cactus on high points outside the basins.



Top Right | Recently installed sediment trap—a rock apron set adjacent to the curb cut to capture sediments in stormwater before moving into the basin.
Bottom Right | Sediment needs to be removed occasionally from sediment traps, as was done in this basin.

Snow blankets a newly planted rain garden at WMG's Living Lab. Native plants should be unharmed by snow, but newly planted or younger plants may be susceptible to freezing temperatures.

Winter

(December-February): cold, wet, calm, dormant.

The cool season is a great time to spend outdoors in milder temperatures. Many desert perennial plants and trees go dormant during the winter, while other plants get a burst of growth with the winter rains. While there are only a few below-freezing nights in the lowlands, the mountains all around may experience low-lying clouds and even snow.

SEASONAL HIGHLIGHTS

Several signature Sonoran species may go dormant during this time in response to freezing temperatures, including mesquite, palo verde, and sycamore. Other rain opportunists, like creosote, ocotillo, and wolfberries, may sprout new leaves with winter storms.

Though these native desert willow trees are dormant in the winter, they will benefit from the stored soil moisture from winter rains.

WHAT TO LOOK FOR

Major pruning of dormant trees

- Prune during winter when aiming to overall reduce a tree's size or reach. Pruning during the winter when trees are dormant can minimize the risk of pest problems and infection via wounds.
- Be careful of pruning freeze-sensitive species such as Ironwood trees. These are best to prune in the spring, after any potential for freezing nights. If a freeze has caused them to die back partially, wait until late spring to remove dead material.

Weed winter annuals

- Cheeseweed is an invasive winter annual that, luckily, can be easily identified and removed early on. It is also edible, but it can spread quickly across a landscape and be much more difficult to remove later. Keep a vigilant eye out for it!
- London rocket is in the mustard family, making it a spicy, edible, and opportunistic invasive. London rocket creates large seed banks and must be weeded before it goes to seed each year. If weeded proactively, seed banks can be greatly reduced, if not totally eliminated, over time.

Mulch build up and root rot

- Check the base of woody-stemmed shrubs and trees for peeling or dampness. The "root flare" of the plant (where the woody stem meets the soil at the base of the trunk before spreading out into the underground root system) should not be buried deep in soil. Brush your mulch back a few inches if flares are buried by winter litter.
- Ensure irrigation systems are turned off or turned down during the rainy season to prevent water waste, over-saturation, and excess moisture in plants. Trees and woody-stemmed plants are especially prone to rot.

This native hopseed bush partially died back due to freezing temperatures. Wait to prune back dead branches until springtime, when all danger of frosts have passed. The dead branches help protect the plant from future freezes that season.

TROUBLESHOOTING

Why isn't my basin filling with rainwater?

There are a few reasons why a basin might not be filling during a winter storm. Consider the following:

- Clogs change the flow path of water and have the potential to introduce unexpected erosion.
- Address clogs before the first major storm and occasionally throughout the season.
- Winter rains are soft and gentle over extended periods. The soil is soaking in the rain as it falls and may produce little to no runoff.

This curb core is clogged with leaf litter and trash. Make sure to check and clear basin inlets, such as curb cuts and curb cores, to ensure stormwater can flow into basins during rainy seasons.

BEST PRACTICES

Do's

Prune minimally

- Never remove more than 20% of your tree's canopy in one pruning session. Let your plants grow and prune minimally. Plants should not be pruned at all within the first 2-3 years of their establishment. You'll be pleased with the results - stronger branches, healthier plants, unique shapes, and better wildlife habitat.

Chop and Drop!

- The trimmings of trees and shrubs are valuable to build nutrients in the soil. If you have basins with organic mulch covering your landscape, you can chop and drop the prunings from your tree.
- Prune branches, then chop them into pieces 3 to 6 inches long and drop them in your basin. For larger branches, use them around your landscape as habitat for lizards and insects. Drill some half-inch wide, two-inch deep holes to provide bee nesting habitat.

Don'ts

Don't let your mulch get washed away

- Organic mulch may float away when basins fill with water, in high-flow areas, or in basins that are designed for water to flow through. Plants and rock features can help keep mulch in place, but if your mulch is consistently washed away in rainstorms, consider rock or gravel mulch.
- Design for what is called an "eddy" or "backwater" basin or a "combined inflow, overflow" basin. These have a single location where water enters and exits. This allows organic mulch to flood and circulate within the basin, rather than being drawn through and out of the basin back into the street or other area where it is unwanted.

Organic mulch can float when basins fill with water. In areas where stormwater flows through, you may need to use gravel mulch instead.

Your Sonoran Desert Rain Garden Plant Guide

The Good: Native Pollinators

Let these native plants thrive, and you will have a colorful landscape that attracts many pollinators! These plants will pop up with seasonal rains and often dry up or go dormant at the end of the rainy season.

ANNUALS

Bladdermallow, *Herissantia crispa*

Desert bluebells, *Phacelia campanularia*

Fleabane, *Erigeron divergens*

Golden crownbeard, *Verbesina encelioides*

Hoary tansyaster, *Machaeranthera canescens*

Arizona caltrop, *Kallstroemia grandiflora*
(Note: looks similar to goat head, so ID carefully)

PERENNIALS

Desert senna, *Senna covesii*

Dogweed, *Thymophylla pentachaeta*

Globe mallow, *Sphaeralcea emoryi*

Parry penstemon, *Penstemon parryi*

Slender goldenweed, *Xanthisma gracile*

Goodding verbena, *Glandularia gooddingii*

The Bad: Invasive Plants

Don't let these villains invade your rain garden! It's best to remove the whole plant and remove them before they seed to reduce spreading.

ANNUALS

London Rocket, *Sisymbrium irio* (a mustard)

Stinknet, *Oncosiphon pilulifer*

Cheeseweed, *Malva parviflora*

Ivyleaf morning glory, *Ipomoea hederacea* (Note: this vine grows aggressively with extra rain, so you may need to trim it back or remove from plants)

Goat head, *Tribulus terrestris* (Note: This invasive plant is a nuisance in human use areas. Be proactive and pull these before seeds form. They are sharp!)

Red brome, *Bromus madritensis*

PERENNIALS

African sumac, *Rhus lancia*
(Note: This tree spreads prolifically)

Fountain grass, *Pennisetum setaceum*

Buffelgrass, *Pennisetum ciliare, Cenchrus ciliaris* (Note: This plant is a real hazard. Make sure you carefully identify buffelgrass. Don't make the mistake of removing native bunch grasses, which look similar to buffelgrass, and are often used in rain gardens. Learn more at **bufflegrass.org**.)

Giant reed cane, *Arundo donax*

Bermuda grass, *Cynodon dactylon* (Note: Tricky to remove. You will need to be diligent to remove Bermuda grass manually. Dig out full root system—up to 1.5 feet deep.)

The Wild: Native Habitat

Keep these native plants, if you like it wild! These plants are great for wildlife habitat, so let loose and let them do their thing.

ANNUALS

Woolly honeysweet, *Tidestromia lanuginosa*

Prairie sunflower, *Helianthus petiolaris*

Scarlet spiderling, *Boerhavia coccinea*

Amaranth or Pigsweed, *Amaranthus palmeri* (Note: leaves and seeds edible)

Purslane or Verdologoas, *Trianthema portulacastrum* (Note: This plant is edible and great for salads, smoothies, and stir-fry.)

Hyssop-leaf sandmat, *Chamaesyce hyssopifolia*

PERENNIALS

Desert hackberry, *Celtis pallida*

Wolfberry, *Lycium fremontii*

Brittlebush, *Encelia farinosa*

Thurber's desert honeysuckle, *Anisacanthus thurberi*

GRASSES

Deergrass, *Muhlenbergia rigens*

Purple threeawn, *Aristida purpurea*

The Shade: Native Trees

These trees are native to the Sonoran Desert and pair well with rain gardens. They are hearty species adapted to seasonal rainfall and may grow faster with additional stormwater.

Velvet mesquite, *Prosopis velutina*

Blue palo verde, *Parkinsonia florida*

Catclaw acacia, *Senegalia greggii*

White thorn acacia, *Vachellia constricta*

Foothills palo verde, *Parkinsonia microphylla*

Desert ironwood, *Olneya tesota*

Desert willow, *Chilopsis linearis*

Netleaf hackberry, *Celtis laevigata*

Volunteers care for rain garden at Primera Iglesia in Phoenix, one of the first rain gardens installed in the city utilizing curb cuts.

Watershed Management Group

For additional publications, videos, and classes about rain gardens, visit: **Watershedmg.org**