Slow it. Spread it. Sink it!

A Homeowner's Guide to Turning Runoff into a Resource

Slow it. Spread it. Sink it!

A Homeowner's Guide to Greening Stormwater Runoff

Practical Ways to Protect Your Property
and the Environment from the Effects of Stormwater Runoff

2nd edition June 2015

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STATEMENT OF PURPOSE

This Guide was developed for educational purposes by the Resource Conservation District of Santa Cruz County (RCD). The stormwater runoff improvement practices included in this guide are to be used as general guidelines and are not to be used as professional engineered specifications. Prior to implementation of ANY practices, seek technical assistance from a licensed professional engineer or landscape architect, and/or certified professionals in erosion and sediment control for specifications for these practices. Site-specific designs that address each individual site's needs and constraints are essential.

WHO WE ARE

The Resource Conservation District of Santa Cruz County (RCD) is a special district organized under state law. The RCD is also a public resource agency with no enforcement or regulatory functions. The mission of the RCD is to help people protect, conserve, and restore natural resources through information, education and technical assistance programs.

The RCD works closely with the Natural Resource Conservation Service (NRCS). NRCS, formerly the Soil Conservation Service (SCS), is a non-regulatory, federal agency in the U.S. Department of Agriculture (USDA) created to lead a national effort to prevent erosion and protect the nation's privately owned soils and water resources. NRCS provides free technical assistance through a variety of voluntary programs aimed at helping land users protect, enhance, and wisely use our nation's soil, water, and other natural resources.

Together, through this local partnership, local landowners receive many services including free on-site evaluations that address stormwater management, erosion control, and other resources concerns. Public workshops and trainings related to managing stormwater runoff are also conducted throughout the year. Cost-share, rebates and permitting assistance for qualified projects,is also available.

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Note: Federal, state, and local regulations in California pertain to many of the subjects presented in this guide. Regulations change quickly, as do the technical methods and standards for environmental protection. Be sure to follow applicable regulations covering private land maintenance and related activities for your area.

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DID YOU KNOW?

Something as simple as water from a downspout contributes to a number of unwanted consequences. Roofs and other impervious surfaces alter natural hydrology by increasing the volume and flow patterns of stormwater runoff. This has a variety of impacts including increased rates of erosion and degraded stream and wildlife habitat. Other unintended outcomes associated with accelerated stormwater runoff are road deterioration, damage to structures, beach closures, flooding, and land slides. Fortunately there are simple low-cost actions that we all can take to minimize pollutants and decrease the volume of runoff leaving our properties. Many of these actions have added benefit of beautifying our landscapes too! Please read on.

DID YOU KNOW THAT THIS:

CAN CONTRIBUTE TO THIS:

SO WHY NOT TRY ONE OF THESE?

Here are just a few of the ideas you'll find in this guide to address stormwater runoff around your home.

Collect your roof water in a **RAIN BARREL**.

Cost: LOW
Installation difficulty: EASY
See page 26

Plant a **RAIN GARDEN** in your landscape.

Cost: LOW to MODERATE
Installation difficulty: EASY to INTERMEDIATE
See page 29

Install a **WATERBAR** on your driveway.

Cost: MODERATE
Installation difficulty: INTERMEDIATE
See page 37

Use **PERVIOUS PAVERS** when renovating your patio.

Cost: MODERATE - HIGH
Installation difficulty: INTERMEDIATE
See page 32

Introduction

Of all the problems encountered by homeowners, one of the most common and often overlooked is improperly managed storm water runoff and residential drainage. A heavy rainfall on an average property and its impervious surfaces, such as roofs, patios, driveways and sidewalks, produces a tremendous amount of runoff - it only takes one inch of rain on 1,000 square feet of surface area to generate 600 gallons of water. All this water must go somewhere, and improperly designed or maintained drainage systems can affect what is likely your largest lifetime investment, your home and property! In addition, inadequately managed stormwater can have a negative impact on local creeks and rivers by delivering pollutants and causing significant erosion. And even if runoff is well managed, the increased volume of runoff from impervious surfaces still has an impact. Fortunately, a bit of awareness and planning can fix problems, prevent new ones from occurring, and can turn stormwater runoff into a resource! Improperly managed runoff from your house can cause your basement to flood, the soil under your house to settle or expand, foundations to crack, mold to grow in wet areas, and can even lead to hillslope instability and landslides. But problems associated with poor drainage often do not stop at your property line. Unmanaged water can lead to erosion on neighboring properties, damage to rural roads and costly repairs for landowners and road association members. An increase in impervious surfaces also minimizes infiltration, and by limiting groundwater recharge of aquifers we increase the pressure on Santa Cruz County's water supply.

Historically, the model for stormwater management has been conveyance – i.e. move water away from the site where it falls as quickly and efficiently as possible. Traditional management tools included street gutters and curbs, pipes, and canals to remove water from the developed areas.

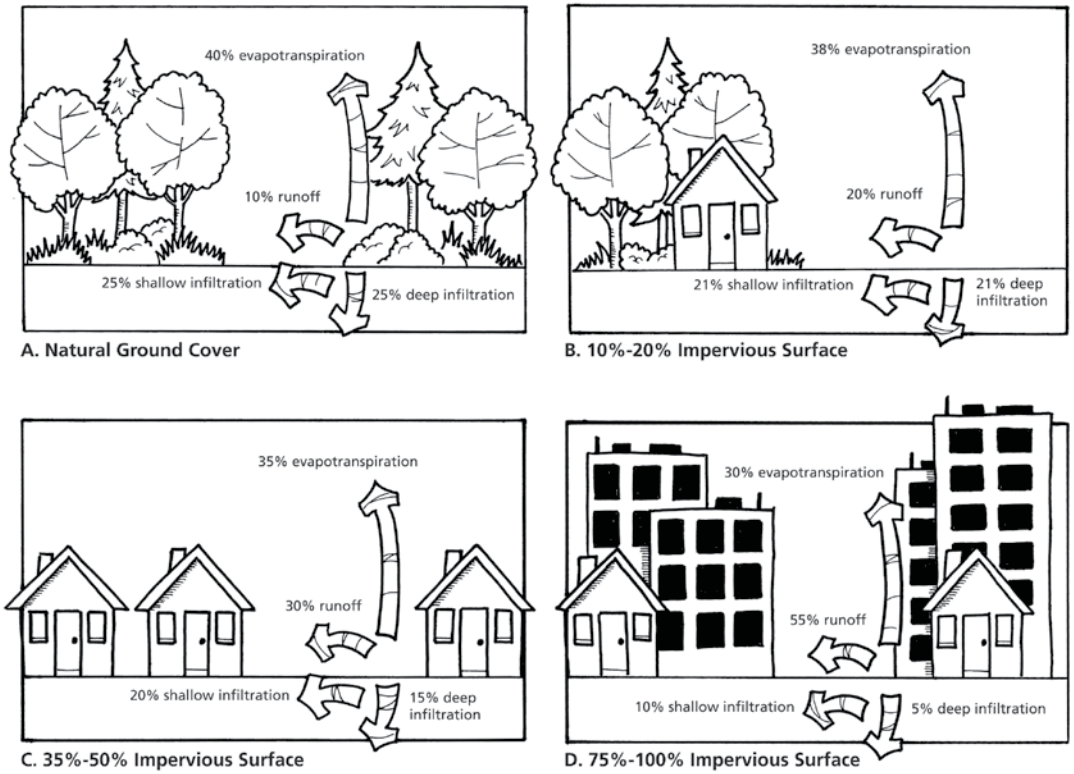


FIGURE 1: PERCENTAGE RUNOFF GENERATED FROM IMPERVIOUS SURFACES, ADAPTED FROM FISRWG 1998

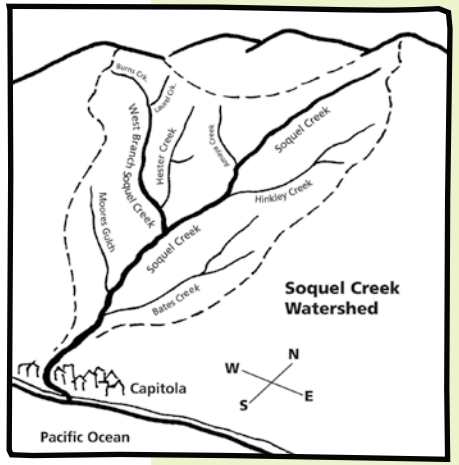
RUNOFF FROM THE SURROUNDING HOMES AND STREETS FLOWS THROUGH THIS STORM DRAIN...

...AND CONTINUES DIRECTLY TO THE SAN LORENZO RIVER.

Even individual home sites were encouraged to send all of their water to the street via driveways, downspouts, and underground outlets. To convey increased stormwater volume, creeks and rivers have been re-shaped and lined with concrete. Detention ponds, some with water quality filtration devices, have also been constructed to regulate discharge and reduce peak flow impacts on receiving waters. For the most part, these practices reduce flood impacts, but do not completely address water quality, and aquatic and riparian habitat degradation issues.

However, a new concept in stormwater management is emerging, called Low-Impact Development (LID), the principles of which can be implemented in new developments, neighborhoods, and incorporated into existing systems around your home. LID seeks to mimic the natural watershed by reducing impervious surfaces, promoting infiltration, filtering runoff, and reducing the peak discharge during flood events. In contrast with the traditional approaches, the guiding principle of the LID approaches is not conveyance, but source control and infiltration. This is achieved through a variety of site design and engineered techniques. Design options might include locating open spaces in low-lying areas to serve as a detention or retention basins and avoiding development on permeable soils to promote infiltration and groundwater recharge. Engineered techniques could include the use of grassy swales, bioretention cells, and porous pavement. Simple things such as routing roof runoff away from the street and into a planted filtration area (rain garden) or capturing and storing rainwater for later use are also great, low-cost options for existing properties. The use of LID concepts can improve environmental quality and have an economic benefit through reduced flooding, maintenance, and mitigation of environmental impacts – not to mention, they will help homeowners solve their most challenging problems related to runoff

In addition to the information provided in this guide the Resource Conservation District of Santa Cruz County (RCD), in partnership with the USDA Natural Resource Conservation Service (NRCS) and other local organizations, offers free technical publications, educational workshops, on-site stormwater runoff evaluations, and cost-share assistance for implementing stormwater Best Management Practices (BMPs). For more information, please visit the RCD online at **www.rcdsantacruz.org**.



DID YOU KNOW?

Just as a city, county, state, or even our personal property has boundaries, so does a watershed. We define a watershed as the land that contributes water to a given area. Watersheds are normally named after the river, creek, or stream that they drain to. For instance, residents of Felton are in the San Lorenzo River Watershed. If you live in Soquel Village or Capitola, you are in the Soquel Creek Watershed. All of the rainfall and runoff from our homes drains into the watershed where it is located, eventually replenishing critical groundwater resources or flowing to the Monterey Bay.

CHAPTER 1

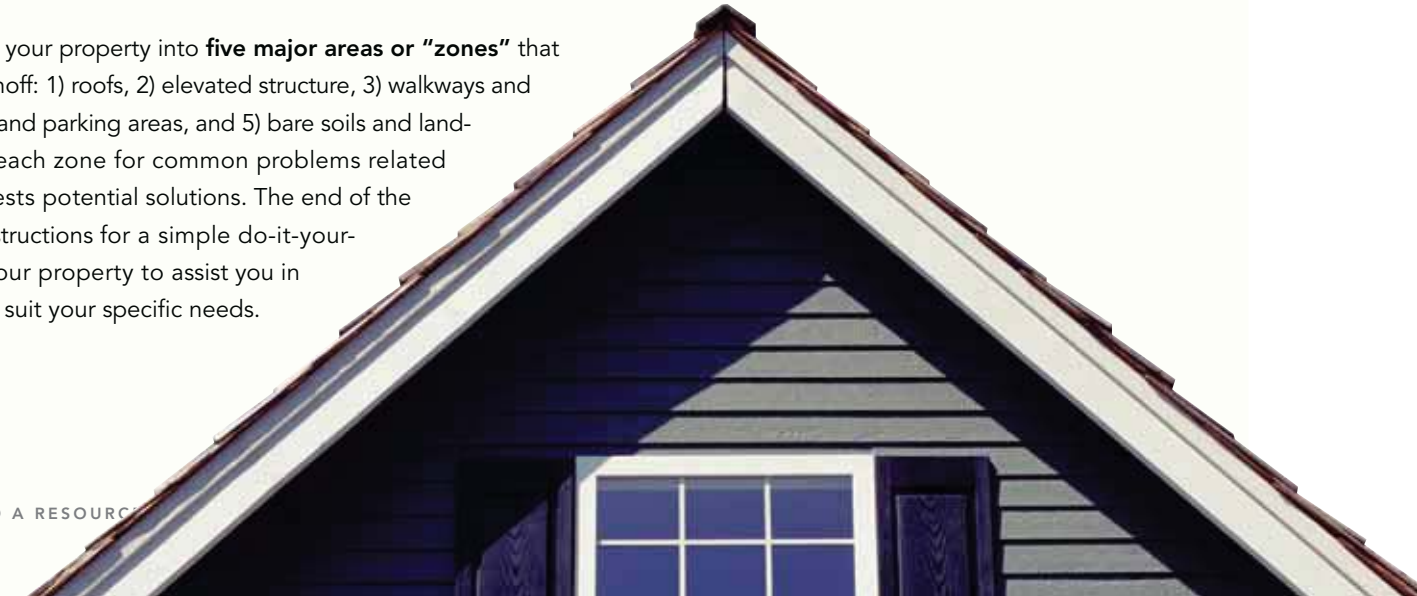
UNDERSTANDING AND EVALUATING STORMWATER RUNOFF AROUND YOUR HOME

Specific actions or practices to minimize the effects of stormwater runoff are called Best Management Practices (BMPs). An example of a BMP is slowing runoff by temporarily storing it in a rain barrel or other detainment system where it can be used to water plants or metered out over the landscape once the rains have passed. Another example is allowing runoff to sink into the ground by directing it to landscape vegetation where sediment can be filtered out and contaminants reduced through bioremediation (use of plants and microorganisms to biologically break down and thereby remove pollutants). Low Impact Development (LID) is another common term normally referred to in larger scale developments that incorporate ecologically friendly stormwater management practices. Because the county is already developed, it is essential that we each do our part to implement stormwater BMPs.

This guide will focus on BMPs that you can implement around your home. The BMPs are not complicated. They are geared toward residential homes or small developments and the underlying concepts behind them follow a simple mantra: **Slow it. Spread it. Sink it!**

- **Slow the runoff down**
- **Spread it out in planters, gardens, or over other pervious surfaces - do not confine runoff to pipes**
- **Sink it back into the ground!**

This chapter divides your property into **five major areas or "zones"** that can contribute to runoff: 1) roofs, 2) elevated structure, 3) walkways and patios, 4) driveways and parking areas, and 5) bare soils and landscapes. It examines each zone for common problems related to runoff and suggests potential solutions. The end of the chapter provides instructions for a simple do-it-yourself evaluation of your property to assist you in choosing BMPs that suit your specific needs.

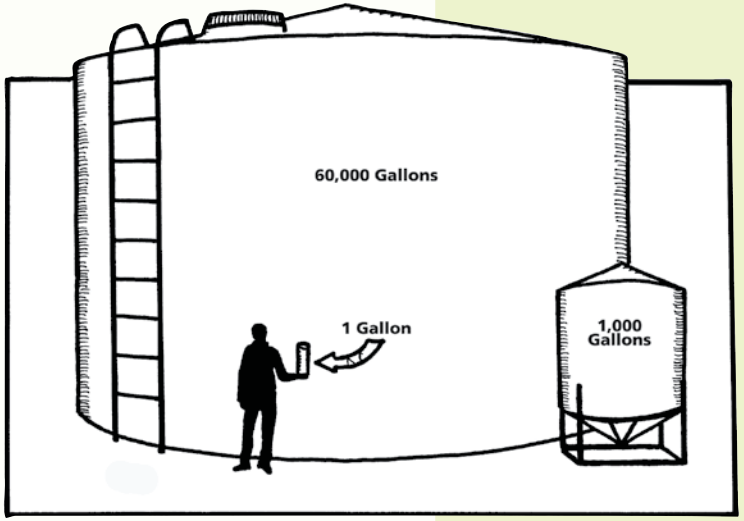


ROOFS

Your roof likely generates the most runoff from your home. While the majority of roofs are outfitted with gutters and downspouts, some are not, so protection measures for either possibility are discussed. Regardless of which system you use, all eaves and downspouts should be routed away from sensitive areas such as septic system leachfields, hillsides, and building foundations.

NON-GUTTERED ROOFS

If it is not possible to install gutters because of cost or other issues, you will need to protect the ground below the eaves which is referred to as the drip-line. Runoff from eaves can cause significant erosion and the resulting moisture can damage foundations and cause unhealthy mold to develop.



DID YOU KNOW?

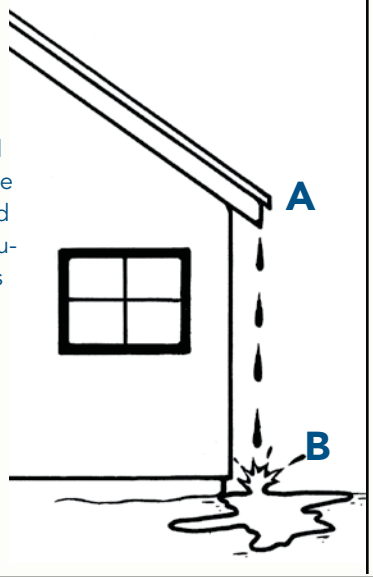
It takes only one inch of rain falling on a typical 1500-square-foot roof to generate approximately 1,000 gallons of runoff. Annual rainfall in Santa Cruz County ranges from 20 to 60 inches depending on where you live (residents at higher elevations generally receive higher amounts of rainfall). This means that in one winter, your roof alone could shed between 20,000 and 60,000 gallons of water as runoff!

POTENTIAL PROBLEMS

A Non-guttered roofs can cause problems along the drip-line of your home.

B Water from a non-guttered roof can cause erosion, damage structures and foundations, and contribute to downstream pollution. Ponding near foundations can also cause unhealthy mold to develop.

Repairing mold and water damage



BMP SOLUTIONS

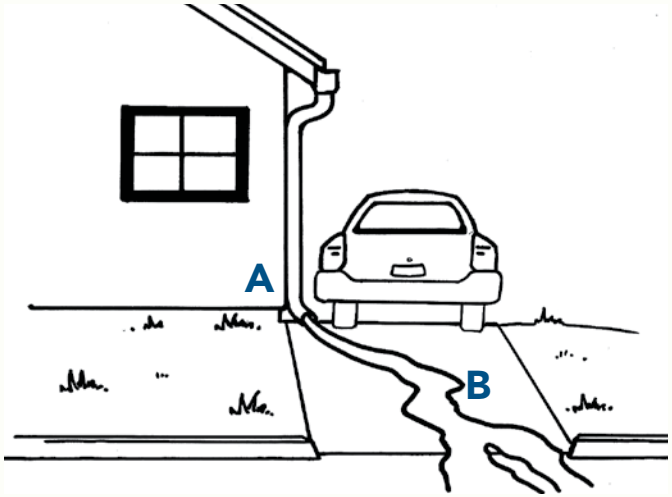
A Adding gutters and downspouts works to direct water to a safe location away from bare soil and buildings (see page 22).

B Vegetated or rock drip-line protection SLOWS runoff thus reducing erosion and promoting Infiltration. It is also designed so that the ground slopes away from the home's foundation (see page 24).

GUTTERED ROOFS

Gutters and downspouts are an excellent choice for handling roof runoff; however, they must be properly sized, managed, and maintained to prevent damage to property and the environment. Undersized gutters clog and overflow more frequently which can damage foundations. Directing downspout runoff toward impervious surfaces like driveways is common but can contribute to downstream flooding, surface water pollution, road damage, stream degradation and other issues. ALWAYS avoid sending runoff towards hillsides, septic system leachfields, and buildings where it can cause significant damage.

POTENTIAL PROBLEMS



A The downspout is directed toward an impervious (concrete) driveway that drains to the street. The resultant runoff may damage roads, exacerbate downstream flooding, or carry pollutants to nearby waterways.

B This driveway is constructed of impervious materials (concrete), and all of the runoff is directed toward the street. The resultant runoff may damage roads, exacerbate downstream flooding, or carry pollutants to nearby waterways.

Runoff from residential homes can carry pollutants to local steams that can be harmful to wildlife.

BMP SOLUTIONS

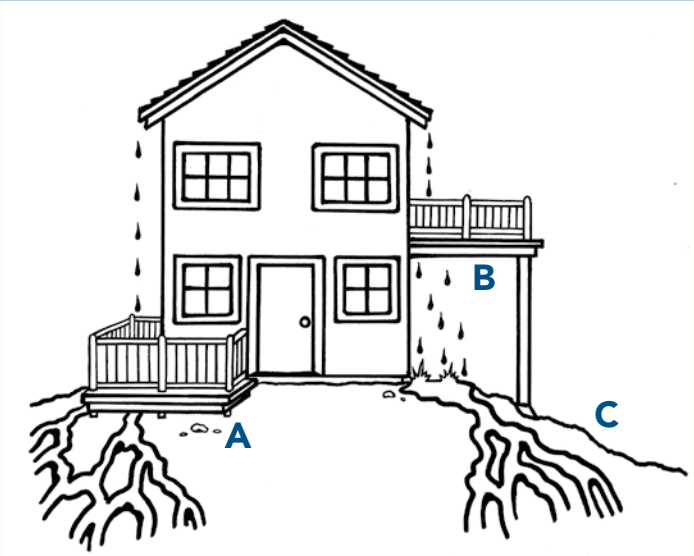
A Rain barrels, downspout diverters, and rain gardens are all potential solutions for treating downspout runoff by SLOWING water down and SPREADING it out (page 26 and 28).

B See Driveways and Parking Areas (page 15).

ELEVATED STRUCTURES

The area underneath decks, outdoor stairs, and other elevated structures where water impacts the ground is called the drip-line. Significant soil loss, damage to supporting structures, or worse can occur if this area is not adequately protected. Where signs of erosion are present such as soil loss or uneven ground from water flow, it is important to take protection measures. Locations with over a 50% slope are particularly vulnerable and may require treatments designed and installed by a qualified licensed professional.

POTENTIAL PROBLEMS



A Low decks may prohibit the addition of protective ground cover, leaving bare soil to erode.

B The runoff from high decks impacts the soil with greater force than low decks. It can cause structural damage to supports and contribute to sediment and other pollutants entering nearby storm drains and streams.

Visible erosion under a deck is common.

C Runoff on steep slopes with bare soils can cause significant erosion and even landslides. Ground covers such as rock and mulch are hard to keep in place and can easily wash away.

BMP SOLUTIONS

A Adding mulch or drain rock on slopes less than 33% or vegetation to the perimeter SLOWS and SPREADS water limiting erosion (pages 24-25).

B Adding drain rock SLOWS runoff and safeguards the drip-line area under elevated surfaces. Mulch around the perimeter adds extra protection to the surrounding bare soil (pages 24-25).

C Terracing or retaining walls may be added to sloped areas to keep rock or other mulch in place and protect hillsides (pages 38-39).

DID YOU KNOW?

It's important to properly dispose of pet waste. Roundworms, E. coli, and Giardia are just a few of the many harmful microorganisms that can be transmitted from pet waste to humans. Some can last in your yard for as long as four years. Children who play outside and adults who garden are at greatest risk of infection. Pet waste is also one of the main sources of bacterial contamination of creeks in Santa Cruz County. The American Pet Products Manufacturers Association claims four in 10 U.S. households have at least one dog. That equates to over 140,000 dogs within the county and incorporated cities! Holy pooch! That's a lot of poop. Let's work to keep our families healthy and waterways clean. The solution is safe and easy: 1. Scoop the poop; 2. Put it in a bag (recycled or biodegradable bags are the best option);

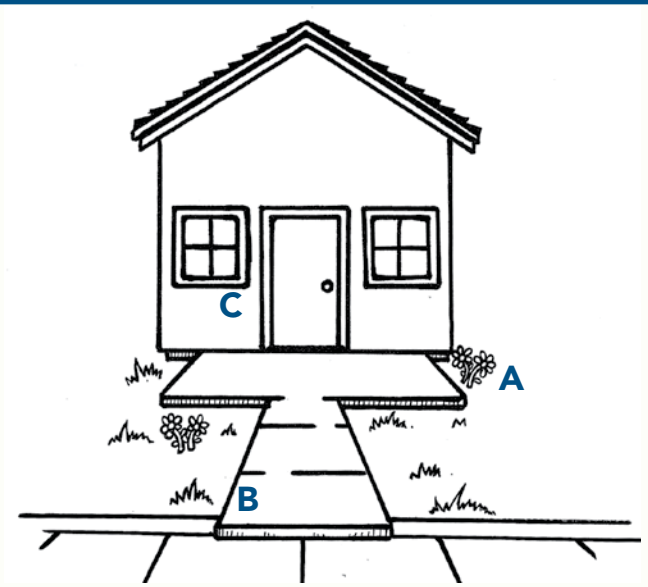
3. Place it in the trash; and

4. Wash your hands.

WALKWAYS AND PATIOS

Walkways and patio areas often become conduits for runoff. For existing paved paths or patios look for areas of standing water or visible signs of erosion where the path or patio surface meets the soil. Does your walkway drain to the street or toward your house? When constructing a new walkway or patio always consider where it will drain. Angle it toward a vegetated area or try one of the new porous materials that will reduce runoff and promote infiltration.

POTENTIAL PROBLEMS



A Foot traffic, even in low use areas, can inhibit plant growth and leave bare soil to erode.

B Walkways or other hard surfaces that drain to the street increase runoff causing problems downstream.

C Hard durable surfaces such as patios are often constructed of concrete or other impervious materials that don't allow runoff to infiltrate.

Residential runoff that drains to the street contributes to localized flooding.

BMP SOLUTIONS

A Mulch, gravel, or wood chips work well in low-traffic areas and allow for more runoff to SINK into the ground (page 34).

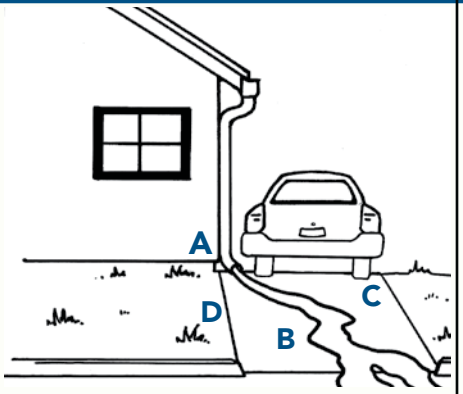
B Turf block works well for allowing water to SINK into the soil in medium-traffic areas or driveways with separate parking areas (page 33).

C Use paver stones for high-traffic areas and patios. For areas with excess runoff, use plant borders to allow more water to SINK into the ground (pages 32 and 35).

DRIVEWAYS AND PARKING AREAS

Traditionally, driveways have been constructed to divert runoff directly to the street. That runoff can carry with it a variety of pollutants, such as oil and grease, soaps from car washing, leaked antifreeze and more. Your driveway can also act as a conduit for large volumes of roof runoff. Concentrating large volumes of water that outlet to the street increases the chances of road damage, flooding, and erosion. Check to see where your driveway water goes and locate the nearest storm drain. There are now many alternatives available to replace impervious concrete and a variety of BMPs for addressing runoff on your driveway or parking areas. For a more thorough discussion on road and driveway treatments, please obtain a copy of the Private Roads Maintenance Guide for Santa Cruz County published by the Resource Conservation District of Santa Cruz County. The guide is available online at **www.rcdsantacruz.org** or through the RCD office.

POTENTIAL PROBLEMS



A The downspout is directed toward an impervious (concrete) driveway that drains to the street. The resultant runoff may damage roads, exacerbate downstream flooding, or carry pollutants to nearby waterways.

B This driveway slopes toward the street and creates runoff potentially contributing to flooding, erosion, and pollutants in nearby storm drains and streams.

C This driveway is also constructed of impervious materials (concrete), and all of the runoff is directed toward the street. The resultant runoff may damage roads, exacerbate downstream flooding, or carry pollutants to nearby waterways.

Driveways can act as conduits for excess amounts of runoff that can damage roads.

D Driveways that do direct water runoff away from the street can still contribute to erosion if the area collecting the runoff is not properly protected or maintained.

BMP SOLUTIONS

A See Guttered Roofs on page 12.

B An asphalt berm, also known as a waterbar, is like a small speed bump set at an angle. It can be added to an existing driveway to SLOW and SPREAD runoff to vegetated or rocked infiltration areas. (page 37).

C Pervious concrete (pictured) or other materials such as paver stones or turf block, allow water to SINK into the soil decreasing runoff (page 33).

D A rocked or vegetated swale lining the edge of a road or driveway reduces erosion potential by SLOWING runoff and then SINKING it back into the soil or directing it to a safer outlet (page 31).

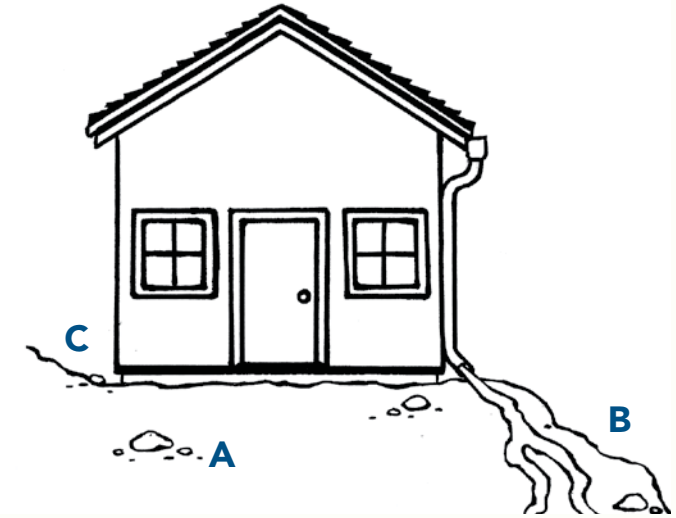
DID YOU KNOW?

We have all heard that cars contribute to air pollution. But, did you know they can also contribute to water pollution? Soap from car washing, oil and grease from leaking engines, zinc from tires, and copper from brakes can all end up in the water where we play, fish, live, and even drink! Keeping cars properly maintained, using commercial car washes, washing vehicles on lawns or gravel parking areas, recycling oil, antifreeze, and used batteries, keeping tires properly inflated, and simply driving less will all contribute to cleaner water for everyone!

BARE SOILS AND LANDSCAPES

Bare soils and sloped areas are the part of any landscape that are most vulnerable to the impacts of runoff. Without a protective cover of vegetation, duff (decaying leaves and needles), or mulch (wood chips, etc.), these areas erode which can reduce soil fertility, compromise support structures for decks and buildings, and in extreme cases, lead to catastrophic events such as landslides. Erosion on bare soils can be identified by uneven soil surfaces, depressions in the soils that create small gullies, and any sign that indicates soil loss. If water is flowing across bare soil anywhere on your property, at least some soil is being carried away (eroding). Since vegetation plays an important role in preventing soil loss, it is important to use plants adapted to your site. Some plants such as certain kinds of ivy or ice plant can actually hinder the stability of sloped areas due to poor root structure or added weight.

POTENTIAL PROBLEMS



A Bare soils are highly susceptible to erosion.

B In steeply sloped or hilly areas soil erosion is not only harmful to the environment, but it can pose a serious threat to life and limb when land movement occurs.

C Moderately sloped areas are also prone to erosion and can cause damage to surrounding structures if they become unstable.

Bare soils are susceptible to erosion and increase runoff, that delivers sediments and other pollutants to streets and storm drains and eventually to local waterways.

BMP SOLUTIONS

A Mulch protects soil from direct rainfall impact and SLOWS runoff across bare soils (page 34).

B Retaining walls help hold sloped areas in place and SLOW runoff. They also add beauty to a landscape and can double as benches and planter boxes (page 38).

C Using carefully chosen vegetation can help SLOW and SPREAD runoff in order to prevent soil erosion on hillsides. Ceanothus (pictured) is one example of a shrub that does well in areas with full sun and requires little to no summer water once established (page 35).

ASSESSING YOUR PROPERTY'S POTENTIAL: DO-IT-YOURSELF STORMWATER RUNOFF EVALUATION

Completing this simple assessment will help you discover areas on your property to install practices that conserve water and manage rain water. It consists of a walk around your property to record observations of stormwater runoff, soil types, and current landscape management practices, take measurements, estimate the volume of stormwater runoff, and identify what types of landscape improvements could be made to beautify your yard and protect our valuable water resources.

TOOLS.

- rainfall data
- calculator
- shovel and water (perc test)
- property sketch or map
- clip board and pencil
- umbrella and rain gear
- waterproof camera
- measuring tape/ruler

CREATE A SKETCH. Your sketch will be used to record observations about how stormwater moves across your property and to estimate the total volume of stormwater runoff that originates from your property. The simple sketch should be a birds-eye view and include property lines, footprint of your house, buildings, driveways, areas of bare soil and any major vegetation (trees, lawns, etc.).

WALK YOUR PROPERTY. With your property sketch completed, you are ready to head outside. We recommend two different walks. First, on a dry day to take measurements of hardened areas (roofs, driveways and parking areas) and record current landscape management practices (fertilization, pesticide controls, yard waste, and irrigation). Second, take a walk on a rainy day to observe rain water flows. For the most accurate results, do not choose the first storm of the season or go out during the first few minutes of rain. Wait until there have been at least one or two good rain events (more than a ½ inch), then go out during a subsequent storm once you see water flowing on your property. During the walk, record rain water runoff observations by drawing arrows that follow the direction water is moving on your property (see sample drawing). Also note how close you are to the nearest stream, storm drain, or ditch that carries water away from your property. Bring your camera and take lots of pictures. Pay special attention in areas where water is flowing quickly or ponding. You can use the photos when evaluating practices to install.

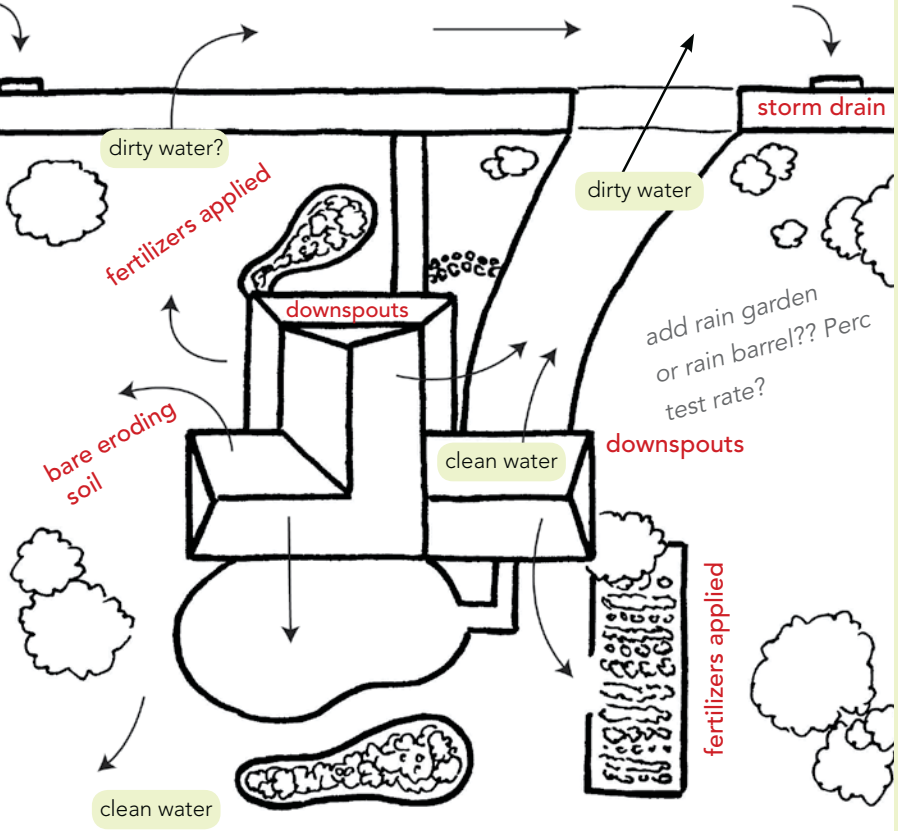
ESTIMATE TOTAL POTENTIAL VOLUME OF RUNOFF. To calculate the total volume of potential rain water runoff generated on your property, you will need to know the square footage of hardened areas where rain water doesn't soak back into the ground (e.g. roofs and driveways) and the annual rainfall in your location (see page 19 for annual rainfall map of Santa Cruz County). On average, a 1,000 square foot hard surface will generate approximately 620 gallons of runoff per inch of rain.

_____	X	_____	X	0.62	=	_____
square footage of impervious area		annual rainfall				gallons of runoff

Another useful number is the inches of rain that could fall in a 24 hour storm event. Your local agency stormwater departments should have maps (85th and 95th percentile rainfall depths) for your area. These numbers are helpful for designing a landscape feature can infiltrate all of the runoff in most storms. New permitted developments are required to design for this.

ASSESS YOUR SOILS! This is one of the most critical pieces of information you need. You can start with looking at the soil maps available through the local RCD and NRCS offices and online at www.rcdsantacruz.org—Resources for Professionals. However, it is highly recommended that you conduct a simple percolation test or consult a professional for an evaluation of the soils at your location. Soils with poor infiltration rates may not be good candidates for certain infiltration practices without additional engineered features.

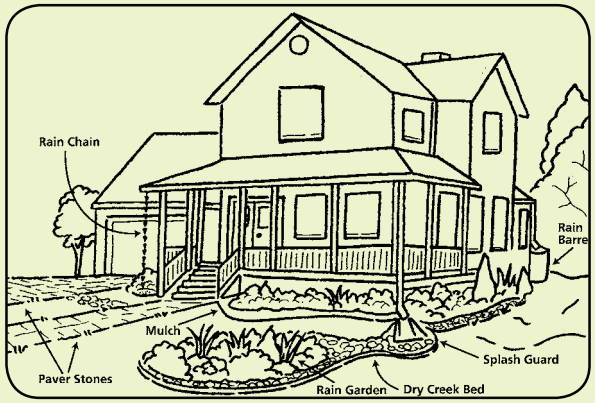
EVALUATE YOUR RESULTS. Using your results, determine what practices you might employ to beautify your landscape, protect your property, reduce flooding, and help improve local water quality. Note them on your property sketch. Contact your local RCD office for additional assistance in planning your landscape design. Funding assistance may also be available through the RCD or your local water district.



Sample site drawing.

DID YOU INCLUDE?

- Note where you might find "dirty" vs. "clean" water? If you have "dirty" water flowing to a waterbody or storm drain, what might you do to keep it clean?
- What direction is water flowing? Does it drain to vegetated areas or to impervious surfaces such as driveways and streets?
- Where is the closest storm drain or creek?
- Do you have areas of standing water? Poor soil infiltration may be indicated by standing water that does not drain within 24 hours.
- Do you have runoff from your irrigation water?
- Do you have runoff from a neighboring property entering your property or vice versa?
- Do you have runoff draining to a steep slope?



Native plants, a "hollywood" driveway, rain water catchment, dry creek beds and pervious pavers are all great landscape options to **slow it, spread it and sink it!**

OTHER CONSIDERATIONS

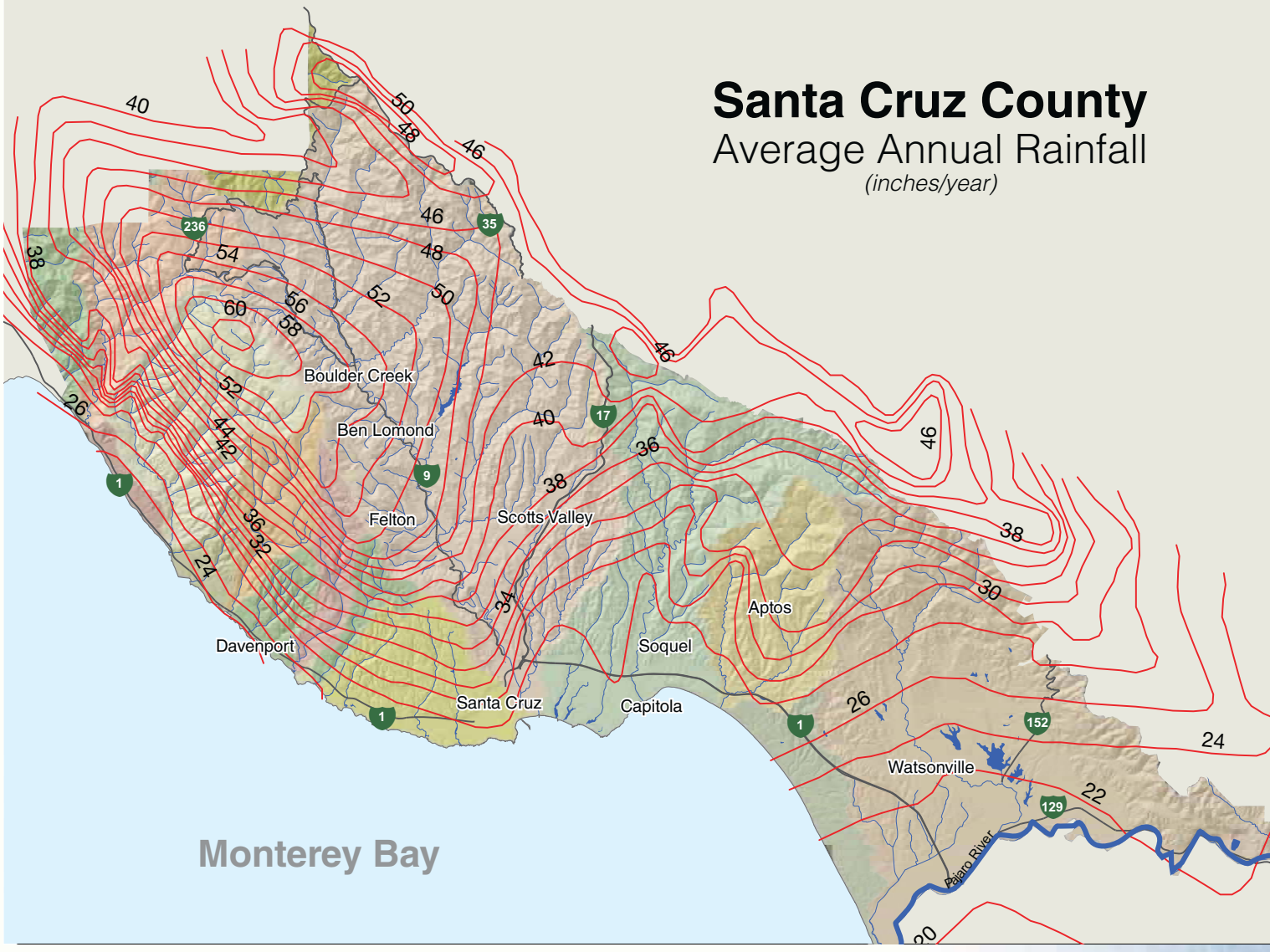
KEEP CLEAN WATER CLEAN. Rain water runoff is considered "clean" when it's generated from a surface that has no potential contaminants such as runoff from your roof. "Dirty" water would be runoff that has traveled across a surface that contains material that could potentially degrade water quality, such as motor oil, sediment, fertilizers, pesticides or animal waste. It is important to differentiate between these two types of runoff because there are different practices for dealing clean water versus dirty water. Areas that generate "dirty" water should be routed to a vegetated or other filtration area. This allows the water to naturally "clean" itself before it makes its way to a storm drain or creek. Clean water requires less management and does not need "treatment" before being directed to a storm drain.

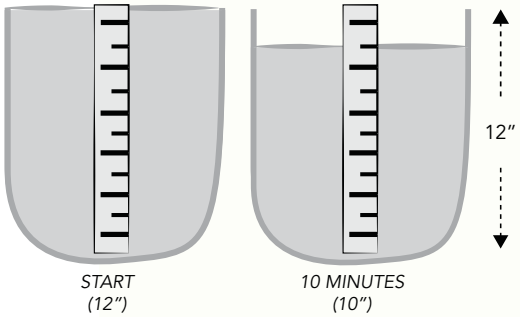
MAINTENANCE. Always understand the maintenance requirements of whatever practices you install. Rain barrels require periodic sediment removal, drains require cleaning, and pervious pavements may require "vacuuming."

SAFETY. Never route stormwater to an unstable or steep hillside or other area that could pose a safety hazard (see Chapter 3). For more information on safety concerns or for a free assessment of your property, contact the Resource Conservation District, the Natural Resources Conservation Service or other qualified professional.

ANNUAL RAINFALL. Using the map on he left of you live in Santa Cruz County, find the approximate location of your property. Find the closest red line and the matching annual rainfall in inches. You can use this number to estimate the volume of water collected on your roof or other hard surfaces where there is no opportunity for infiltration. Adding all of those surfaces together will provide you with the total annual volume of runoff for your property. Installing landscape features that allow even some of this water to soak back into the ground or collect it for irrigation or other uses will benefit our local water resources.

PERC TEST. A percolation test, sometimes referred to as a "perc test," determines how quickly water can move through the soil when saturated. This helps determine if your property has good soils for infiltration BMPs like rain gardnes.





A good time to do the test is after a rain.

1. Dig 1x1x1 foot hole.

2. Insert a 12 inch or greater ruler.

3. Fill hole with water and leave overnight.

4. Return the next day and fill the hole with water. Record the starting water level on the ruler in inches. After 10 minutes, record the ending water level in inches. Calculate the difference and multiple by six. Repeat this three times. This will give you an idea of how quickly your soil drains. Heavy clay soils may need as much as two to three hour to get a good recording.

When you get two or more similar readings, that's your percolation measurement. Fast = 1" or more per hour, medium=1/4" - 1/2" per hour, slow less than 1/4" per hour.

CALL BEFORE YOU DIG!

Underground Service Alert (USA) is a FREE service available to anyone planning a project that entails digging. It is simple and easy to use. Before calling USA, outline your digging location with temporary white chalk paint or another medium clear enough to enable USA underground facility members to determine the area of digging. Two working days BEFORE you start your project, call 811 or 1-800-227-2600. USA will contact the appropriate agencies to come and mark any utilities that interfere with your project location. For more detailed information, visit USA North online at www.usanorth.org.

CHAPTER 2

BEST MANAGEMENT PRACTICES FOR STORMWATER RUNOFF AROUND YOUR HOME

Disclaimer: The Best Management Practices (BMPs) described in this guide are provided exclusively for general educational and information purposes. The guide is intended to help landowners consider their current runoff practices and to identify concerns and potential solutions. Any BMP should be installed with the consultation of an experienced professional who can address specific site conditions. This chapter outlines a number of well-established practices along with recently introduced options for managing stormwater runoff.

Managing stormwater on your property is not a new idea. Most residential homes were constructed using the runoff methods of the era in which they were built. For the past 50 years, that approach has been to direct runoff away from the property as quickly as possible using pipes and pavement. While largely effective to reduce flooding, we now recognize that this approach has many unintended consequences. We are now experiencing these in a variety of ways including increased potential for flooding, damage to public and private property, stress on our water supplies, and degradation of our local waterways and habitats. The **Best Management Practices or BMPs** (practices thought to be the most practical and cost-effective) recommended in this guide move away from the old "pipe it and pave it" model and toward the slow it, spread it, sink it approach: Slow the water down, spread the water out, and sink the water into the land. That notion is at the heart of these practices and is a simple mantra you can use to address the runoff on your own property. The following chapter includes information on a variety of BMPs. Find those that best fits your needs, your pocketbook, and your unique site conditions. Following this chapter is a must-read section on difficult locations and site constraints. While this guide presents great ideas, it is critical to recognize when and where they are NOT appropriate.

Before embarking on any new project please remember:

1. In many cases a simple **change in management** of your current system may be all that is needed to minimize negative impacts of stormwater runoff. Each BMP includes details on maintenance. It is important to recognize that each BMP requires ongoing maintenance to remain effective, and to factor this maintenance into your plans. If you already use one of the listed BMPs, please review the maintenance section for tips on getting the most out of your existing features.

2. **Vegetation** plays several important roles in the function of BMPs, which may include:
- Slowing down water and physically removing sediments
- Helping to stabilize slopes through their root structure and reduction of rain impact on the soil
- Biological removal of nutrients and other pollutants (bioremediation)
- Improving soil infiltration

3. **Structural practices** are usually more expensive to install and maintain and place a greater strain on resources and the environment. Structural practices should only be used when management changes or vegetation is not an option.

4. **ALWAYS check with applicable regulatory agencies to determine if a permit is necessary for any project.** Examples of projects for which a permit may be required include building a retaining wall, installing a large cistern, sending runoff to a creek or stream, and directing water to a neighboring property.

5. **CALL BEFORE YOU DIG!** Call 811 or 1-800-227-2600 for assistance from Underground Service Alert (USA).

BENEFITS

- Conserve water
- Create wildlife habitat
- Improve landscape aesthetics
- Reduce peak flows or runoff timing
- Reduce erosion
- Protect infrastructure

COST

- $ Low cost
- $$ Medium cost
- $$$ High cost

INSTALLATION DIFFICULTY

- E Easy
- M Moderate
- C Complex

The **Best Management Practices (BMPs)** described in this chapter include general information to help guide you in choosing option that fit you needs. Each description will also indicate the expected benefits, a qualitative cost range of low to high, and a level of difficulty for installation by the homeowner. It is additionally noted where using a qualified licensed professional is highly recommended.

Conserve water: Water can be conserved by capturing rainwater and saving it for later use, using plants with low water needs OR directing runoff water to areas where it can be stored in the soil for later use by plants.

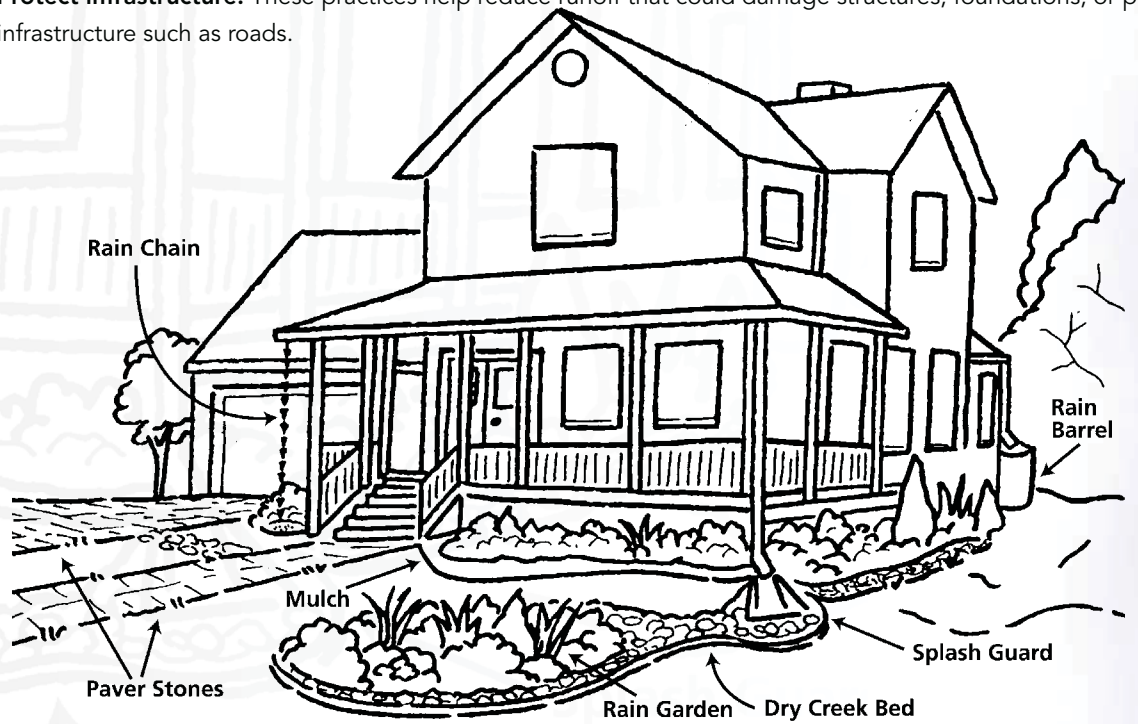
Create wildlife habitat: Choose appropriate plants that provide habitat for local wildlife and act as natural pest control.

Improve landscape aesthetics: Many of the BMPs not only serve a useful function, can be designed to beautify your landscape.

Reduce peak flows or facilitate runoff timing: Changing the timing of residential runoff will reduce peak flows and mitigate flooding.

Reduce Erosion: Practices that reduce erosion limit the loss of top soil and reduce the volume sediments entering local streams.

Protect infrastructure: These practices help reduce runoff that could damage structures, foundations, or public infrastructure such as roads.



Gutters and Downspouts

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USES: ROOF RUNOFF

Santa Cruz County and the incorporated cities may have specific requirements for installing gutters and downspouts. Since requirements often change, we have provided general guidelines, but you should contact your respective planning/building department for more detailed information.

NEW INSTALLATIONS OR RETROFITS

Properly sized gutters and downspouts are crucial for performance. While installation is fairly simple, calculating the correct size system for your roof can prove more difficult. You will need to know your roof area and pitch or slope and your location's annual rainfall. We recommended contacting the RCD or a local qualified professional to assist with calculating correct gutter and downspout sizes.

Also consider where your downspouts drain. Wherever possible and safe, divert downspouts AWAY from impervious surfaces such as concrete driveways, walkways, or compacted soils. Instead direct them to well vegetated areas of your property to allow runoff to **SINK** into the soil. This decreases water volume on streets and in storm drains and reduces the potential for downstream flooding.

The following are general guidelines for selecting and installing gutters and downspouts or improving capacity.

GUTTERS

Select gutters at least 5 inches wide. Use materials made from galvanized steel (29 gauge minimum) or aluminum (.025 inch minimum). To enhance flow, slope gutters according to the manufacturer's recommendations (commonly 1/16 inch to 1/8 inch per 1 foot of sectional gutter; or 1/16 to 1/8 inch per 10 feet of seamless gutters). Tilt the gutter forward keeping the front 1/2 inch lower than the back. For straight runs exceeding 40 feet, use expansion joints at connections. Select elbows with 45, 60, 75 or 90 degree angles, as needed.

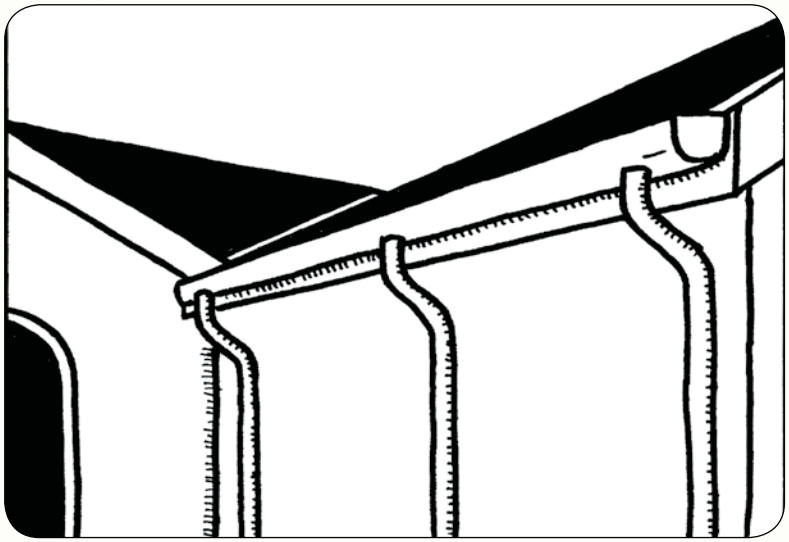
GUTTER PROFILES

Half Round Ogee

Gutters not only come in different sizes, they also come in different shapes. It's important to understand that the shape of your gutter determines the amount of water it can handle during a storm. Ogee shaped gutters, for example, can hold more water than rounded gutters. However the ogee gutter's sharp edges and corners can collect sediment and debris.

DOWNSPOUTS

Space downspouts between 20 to 50 feet apart. Adding additional downspouts increases capacity, where necessary, and help **SLOW** water down and **SPREAD** it out. Do not exceed 45-degree angle bends. Where needed use 4-inch-diameter extensions (flexible or rigid) to convey water to infiltration areas such as rain gardens and swales or to other safe outlets away from structures and steep slopes. All downspouts and pipes that outlet onto surfaces without substantial vegetation cover should use one of the outlet protection BMPs described on page 28. Do not direct downspout outlets to driveways or other impervious surfaces unless there are no safe alternatives. Instead, route them to vegetated areas.



Adding an additional downspout helps reduce the volume and velocity of runoff at any given point reducing the potential for erosion.

MAINTENANCE: Setting up a maintenance schedule is one of the easiest and most cost-effective solutions to many roof runoff issues. Clean your gutters at the beginning of each rainy season and as needed throughout the winter, especially after severe storms. In areas with dense trees or vegetation, trim trees and vines away from gutters to maintain a minimum 24-inch clearance zone. Add gutter guards to reduce debris buildup. You can also add a drip-line treatment (page 24-25) below gutters that clog often. Check your system for leaks, damaged parts, rust, and evidence of past erosion. Make sure to check hidden outlets under decks or staircases that might be forgotten.

DID YOU KNOW?

A RAIN CHAIN can be used instead of a downspout. Rain chains ('kusari dio' in Japanese) have been used for hundreds of years in Japan. Not only are they visually appealing, they also provide some runoff reduction through evaporation and spillage. When installing rain chains, make sure to take the same precautions for outlet protections as you would with standard downspouts. For more information visit a local retailer or www.rainchains.com.

DO

- Direct runoff to a rain garden or swale.
- Collect runoff in a rain barrel or cistern.
- Check and clean gutters after severe storms.

DON'T

- Release water onto bare soil.
- Direct runoff to steep slopes or foundations.
- Send runoff onto a neighbor's property.

Drip-Line Protection

USES: BELOW ROOF EAVES, UNDER DECKS OR ELEVATED STRUCTURES

A drip-line is the area below any elevated surface that receives runoff. For roofs it is the ground below eaves that do not have gutters installed. For decks and other elevated surfaces it is the area underneath where water drips through (e.g., the area between and below the deck boards). Drip-line BMPs create a barrier to protect exposed soil and reduce erosion. The protective cover also **SLOWS** runoff and allows it to **SINK** back into the soil. This is critical in areas where runoff-induced erosion could reduce the effectiveness of support structures and footings. Drip-line protection is also a great addition where gutters frequently overflow due to large amounts of debris

VEGETATION PROTECTION FOR DRIP-LINES

Roof drip-lines: Homeowners can establish and maintain mature vegetation below their roof drip-lines. If there is existing vegetation (such as turf or a bordered planter bed), simply maintain these areas. Examples of adequate drip-line vegetation include the following:

- Healthy grass or turf that has been established directly up to the foundation of your home
- Plants, shrubs, or flower beds that are completely bordered by wood, rock, or turf with mulch between vegetation covering any bare soil

Contact the RCD, the local native plant society (NPS), native plant nursery, or a qualified professional for assistance with plants well-adapted to your specific location. See the Resource section for contact information.

Deck/stair drip-lines: Where adequate sunlight is available, planting hardy ground cover, grasses, or other low growing vegetation is a good low-cost option for protecting soil from erosion beneath decks and stairs. Use drought tolerant plants that do not require supplemental watering once established to prevent additional runoff or water near a structure. If you have structures on your property that are low to the ground and are inaccessible underneath, try planting around the perimeter.

MAINTENANCE: Periodic mowing, pruning, and replacement of plants is needed. Inspect the foundation to ensure water is not saturating or eroding structure or foundation. Keep fertilization to a minimum as it can contribute to excess nutrients in runoff. If you do fertilize, always carefully follow the manufacturer's instructions and never apply in excess or prior to forecasted rain.

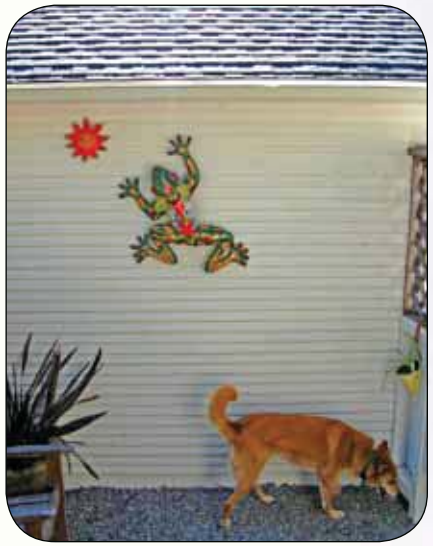
DO

- Use California natives or drought tolerant plants.
- Keep plants well pruned and six inches from structure to allow adequate ventilation.
- Keep soil a minimum of 6 inches below siding.
- Try organic fertilizers and pest controls.

DON'T

- Plant invasive species such as perwinkle (Vinca Major) or ivy.
- Plant highly flammable vegetation.
- Allow irrigation water to drain to your driveway, the street, or onto bare soil.

HARDSCAPE PROTECTION FOR DRIP-LINES



Roof drip-lines: Wood chips, mulch, or gravel can be used to protect soil from erosion and promote infiltration into soils with high permeability (sandy soils). Install gravel or mulch under the drip-line at a minimum depth of 3 inches. This treatment must extend 6 inches inside the eaves and a minimum of 12 inches beyond the eaves of a single-story roof, 18 inches beyond the eaves of a two-story roof, and 24 inches beyond the eaves of a three-story roof. This treatment prevents erosion and allows runoff to infiltrate. Three-quarter inch to one and a half inch washed drain rock is an adequate size to prevent the rock from being moved by rainfall; however, you can use any kind of rock you would like to achieve desired aesthetic effects on your property. Installing non-woven geotextile fabric beneath the rock and then bordering the rock with wood or other material will reduce maintenance and increase effectiveness. You also need to ensure that the ground slopes slightly (1-2%) AWAY from the structure for a minimum of 5 feet.

Deck/stair drip-lines: To protect the soil under elevated decks, stairs, and walkways from erosion, install a three-inch layer of drain rock under the entire footprint of the structure and extend one foot past its edge. If you have structures on your property that are low to the ground and are inaccessible underneath, install a three-inch layer of rock or other mulch approximately twelve inches wide around the outside perimeter of the structures. This treatment will slow runoff velocity and reduce erosion potential. It is only necessary to install drain rock under and around these structures if there is not adequate vegetation established. Installing non-woven geotextile fabric beneath the rock and then bordering the rock with wood or other material will reduce maintenance, help control weeds, and increase effectiveness. You also want to ensure that the ground slopes slightly (1-2%) AWAY from the structure for a minimum of 5 feet.

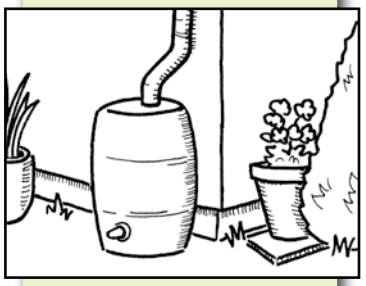
MAINTENANCE: Periodic replacement of gravel or mulch will be needed. Inspect the foundation to ensure that water is not saturating or eroding either the structure or the foundation.

DO

- Use existing rock or mulch from your property.
- Use rock from a local quarry.
- Make sure rock is washed.

DON'T

- Use rock under three-quarter inch in size.
- Allow runoff to flow TOWARD the house or structure.



Rainwater Collection Systems

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USES: COLLECT AND STORE WATER FROM ROOFS

Rainwater collection is an excellent opportunity to **SLOW** water down by temporarily storing it. Captured water can be reused for irrigation or other non-potable options or metered off slowly after storm events to allow for infiltration and reduced flooding.

RAIN BARRELS are small- to medium-sized containers placed outside buildings and connected to roof downspouts to collect runoff for later use in non-potable applications. Rain barrels have many advantages in urban settings. They take up very little space, are inexpensive, and easy to install. Rain barrels conserve water and reduce the volume of runoff moving off-site.

MAINTENANCE: Rain barrels require regular draining after rain-storms and removal of leaves and debris collected on screens. Always check that the overflow is clear and directed to an appropriate location.

DID YOU KNOW?

Sediment and debris that collect in the corners and edges of gutters support the growth of bacteria and other organisms that could contaminate rainwater. Because rounded gutter systems have fewer edges than their square-cornered counterparts, they provide cleaner water for rainwater catchment systems.

DO

- Use water regularly (e.g., water indoor plants).
- Use gravity to your advantage.
- Use multiple barrels where possible.
- Keep covered to eliminate debris and mosquito breeding.

DON'T

- Allow access for mosquitos, rodents, children, pets, or debris.
- Use for drinking.
- Capture water from roofs with excessive debris (e.g., leaves, pine needles, or bird droppings.)

WATER TANKS (CISTERNS) are manufactured water storage containers for non-potable use in residential, commercial, or industrial applications. Water tanks can be installed both above and below ground. Some tanks come as sectional pieces that can be put together to fit different space constraints. Tanks can be used with most guttered roofs to collect runoff and reduce runoff volume. Both water tanks and rain barrels can be used without pumping devices, instead relying on gravity flow. However, depending on the desired use for the water, a pump may be necessary for best performance.

Larger tanks can be designed to also function as privacy screens, fences, or small retaining walls. Tanks can also be hidden under decks or serve as the foundation for play structures or other landscape features. Get creative, but always check local ordinances.

Underground tanks are excellent options for areas with limited space. However, do not install underground systems beneath the path of vehicles or heavy machinery traffic unless they have been engineered for that purpose. Extra precautions may be needed when placing tanks in locations with high water tables or saturated clay soils. Contact an experienced licensed professional for before installing tanks/cisterns.

Underground systems can be customized to fit various shapes and sizes using these modular RainBoxes.

BASIC COMPONENTS OF A RAINWATER COLLECTION SYSTEM:

- **Catchment surface**

  This is normally a roof, but there are other options.

- **Gutters and downspouts**

  Round gutters are recommended because they are less likely to collect sediment in corners and edges which supports bacteria growth.

- **Screening** of tanks or barrels and downspout openings
- **First-flush device**

  Although recommended, this is optional.

- **Water tanks**

  There are various options including manufacturing on-site.

- **Water tank vent**
- **Overflow device**

  This should be equal to or larger in diameter than the inflow pipe to avoid backup.

- **Faucet and valve**
- **Filters and pumps** (optional)

MAINTENANCE: Remove accumulated sediment and debris annually and inspect all components such as gutters and downspouts regularly. The inside the tank must also be inspected. Look for system leaks and cracks. Check all connections and hoses for wear and all screens or mesh for debris accumulation and holes. Make sure overflow is clear and directed to an appropriate location. Inspect all seams for leaks. Follow all manufacturers' recommended maintenance for any storage device.

DO

- Check with your local agency to find out when a permit is needed.
- Secure tanks with straps for protection from earth movement.
- Use gravity to your advantage wherever possible.
- Keep underground tanks a minimum of ¼ full at all times to prevent collapsing of certain tank types.

DON'T

- Place tanks on steep hillsides.
- Place water tanks below ground unless they are approved for this use.
- Collect water from cedar or highly degraded roofs.
- Collect roof water from areas prone to large amounts of debris (leaf litter, etc.)

Outlet Protection

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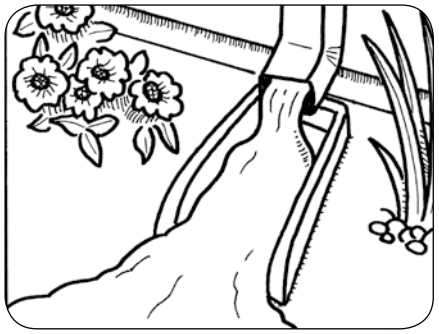
USES: DOWNSPOUT, PIPE, OR CULVERT OUTLETS

One of the most overlooked parts of a drainage system is the outlet of downspouts and pipes. Outlets should not release water onto bare soil or to an area prone to erosion. On the other hand, discharging water onto hardened impervious surface eliminates infiltration and increases the velocity of water that is directed to streets and streams creating a new set of challenges. All outlets that drain onto soils or other erodible surfaces should have some type of outlet protection. The BMPs below work to **SLOW** water down and/or **SPREAD** it out so it can **SINK** back into the soil.



SPLASH GUARDS are simple devices that reduce the initial force of the water at the outlets and allow it to **SPREAD** out into an area of vegetation or an appropriate infiltration area and **SINK** back in to the soil.

A HOSE ADAPTER is an easy option (Drought Buster East Connect is pictured) that allows a standard garden hose to connect directly to a downspout. The hose can then be moved to different locations of your yard when it rains. It is perfect for watering trees or keeping any one area from becoming too saturated by allowing the water to **SPREAD** out through the landscape.

ROCK DISSIPATORS are placed at outlets to **SLOW** runoff by reducing the initial impact of concentrated, high velocity runoff. For downspout outlets there are several easy creative options like filling a large plant container (it must have drain holes) with pebbles or placing rock on the ground surrounded by a wood border (similar to a rock drip-line). Large containers (1/2 wine barrels are an inexpensive option) with established plants and a thick layer of mulch (wood chips or gravel) also work well. Make sure that the drainage from under the pots flows away from your foundation.

For culverts or outlets with drain pipes over 8" in diameter, rock must be properly sized to prevent movement and placed with filter fabric underneath. Angular rock is typically recommended for high velocity flows because it locks in place and has a greater capacity to slow the water than rounded rock or broken concrete which tends to have some smooth edges. Rock should be carefully laid by hand forming an evenly lined depression or basin with no spaces between the rocks. It is highly advisable to contact a licensed qualified professional for design assistance.

Generally speaking, work done at any outlets that drain directly into a waterway will need a permit. Contact the RCD for permitting assistance.

DO

- Direct downspouts to vegetated areas or rock dissipators.
- Protect ALL outlets on your property.

DON'T

- Allow water to pond near foundations.
- Direct water to impervious surfaces that drain directly to the street.

Rain Gardens

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USES: ROOF, WALKWAY, DRIVEWAY, OR PARKING AREA RUNOFF

A **rain garden** is a specialized landscape design that captures stormwater runoff from roofs, driveways, or other impervious surfaces and allows water to **SLOW** down and **SINK** back into the ground. It uses plants to remove pollutants and improve infiltration allowing water to soak back into the ground. In soils with low permeability this system may be used to temporarily store water (not completely infiltrate) and remove pollutants before they enter a waterway.

A rain garden design can be as simple as a shallow depression filled with plants that can flourish in both moist and dry conditions. The required size, shape, and depth of the garden depend on how much water you are trying to capture. For large amounts of runoff or areas with insufficient infiltration, there are a full spectrum of engineered features, such as specialized soil mixtures, an aggregate base, and subsurface drains that can be added. These more complex designs are often referred to as bioretention cells.

Plant the center of the garden with species that tolerate wet conditions, such as native sedges and rushes. Around these, put plants suited to occasional standing water, like Yellow Monkeyflower (*Mimulus guttatus*) or California Aster (*Aster chilensis)*. At the furthermost edges there are a variety of native evergreen and deciduous shrubs that prefer drier soil. Contact a local plant nursery knowledgeable in native and drought tolerant species for more suggestions or visit . Rain gardens should be located at least five feet from your house and property line, three feet from public sidewalks, and at least 40 feet from a septic system or steep slope. They should also be designed to drain within 48 hours to reduce the risk of standing water and mosquito breeding. Rain gardens are a beautiful way to protect your property from erosion and protect the water quality of local creeks. They can enhance the aesthetic value of a site; be used on small parcels of land, easements, and right-of-ways; and are easily incorporated into existing landscapes or open space.

MAINTENANCE: Routine maintenance is required and can be performed as part of the regular site landscaping program. Weeding and irrigation are essential in the first couple of months while plants become established. Annual pruning and mulching are recommended. Additional irrigation may be necessary during drought years. The use of native, site-appropriate vegetation reduces the need for fertilizers, pesticides, excessive water, and overall maintenance.

DO

- Use California native or drought tolerant plants as appropriate.
- Minimize fertilization to prevent water contamination and try organic options.

DON'T

- Site in soils with high water tables or clay soils without an overflow device.
- Place too close to your home's foundation.

Swales

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USES: ROOF, WALKWAY, DRIVEWAY, OR PARKING AREA RUNOFF; LOW TO MODERATELY SLOPED HILLSIDES

Swales are shallow channels designed to **SLOW** water down, **SPREAD** it out and allow it to **SINK** into the soil during low flows. Once saturated, they convey water to a safe outlet such as a rain garden (page 29) or other infiltration areas. They can be formed to fit almost all site conditions and landowner objectives. Depending on the existing landscape and available space, swales can have a meandering or nearly straight alignment. An advantage to a meandering swale is that its geometry maximizes the time water spends in the swale thus aiding the trapping of pollutants and sediments and infiltration. There are two types of swale systems: vegetated or rock-lined (sometimes called dry creek beds).

VEGETATED SWALES

Grassed swales are vegetated with native perennial grass species along the bottom and sides of the channel. The vegetation in the channel slows runoff, allows sediments to filter out, and can help remove nutrients. Bioswales are vegetated swales that use engineered media (usually a designed soil mix consisting of sand, loam soil and hardwood mulch) beneath the swale to improve water quality, reduce runoff volume, and control peak runoff rates. Although their functions are similar to grassed swales, bioswales have a greater capacity for water retention, nutrient removal, and pollutant removal. Adding gravel or other permeable material below the soil mixture further enhances infiltration.

When installing a swale, use a minimum 2% slope from beginning to end (longitudinal slope) to ensure that water is conveyed away from any structures and to a desired destination. **Vegetation in the swale should be established before the first winter storms**, so plant accordingly. Once saturated, swales function as conveyance structures carrying runoff to a rain garden, wetland, infiltration area, or other safe location. Swales are not recommended for areas that receive large amounts of sediment that can prematurely fill the swale and impede its functionality.

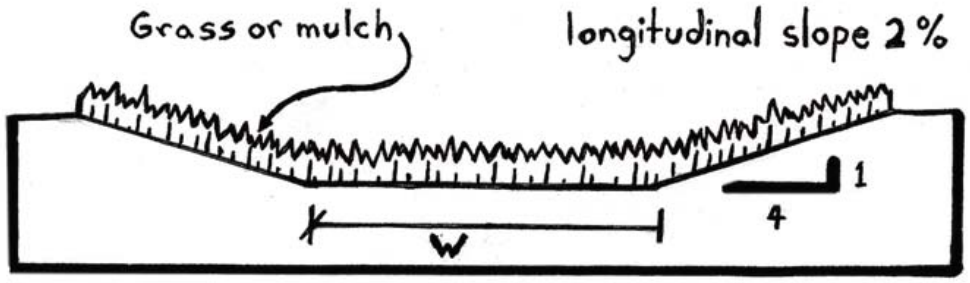
MAINTENANCE: Routine maintenance is required. Before a planted swale is densely vegetated, it is extremely vulnerable to erosion and must be protected with straw matting and other erosion control materials. Maintenance of a dense, healthy vegetated cover consists of periodic mowing (keep grass 2-4 inches high), weed control, reseeding of bare areas, and clearing of debris and accumulated sediment. The swales should be regularly inspected for pools of water, formation of gullies, and for uniformity in cross section width and longitudinal slope. When the uniformity is compromised it should be corrected quickly.

DO

- Use California native plants or drought tolerant plants.
- Use fertilizer and pesticides only when necessary.

DON'T

- Walk or drive machinery directly in the swale as this will cause soil compaction.
- Place too close to your home's foundation.

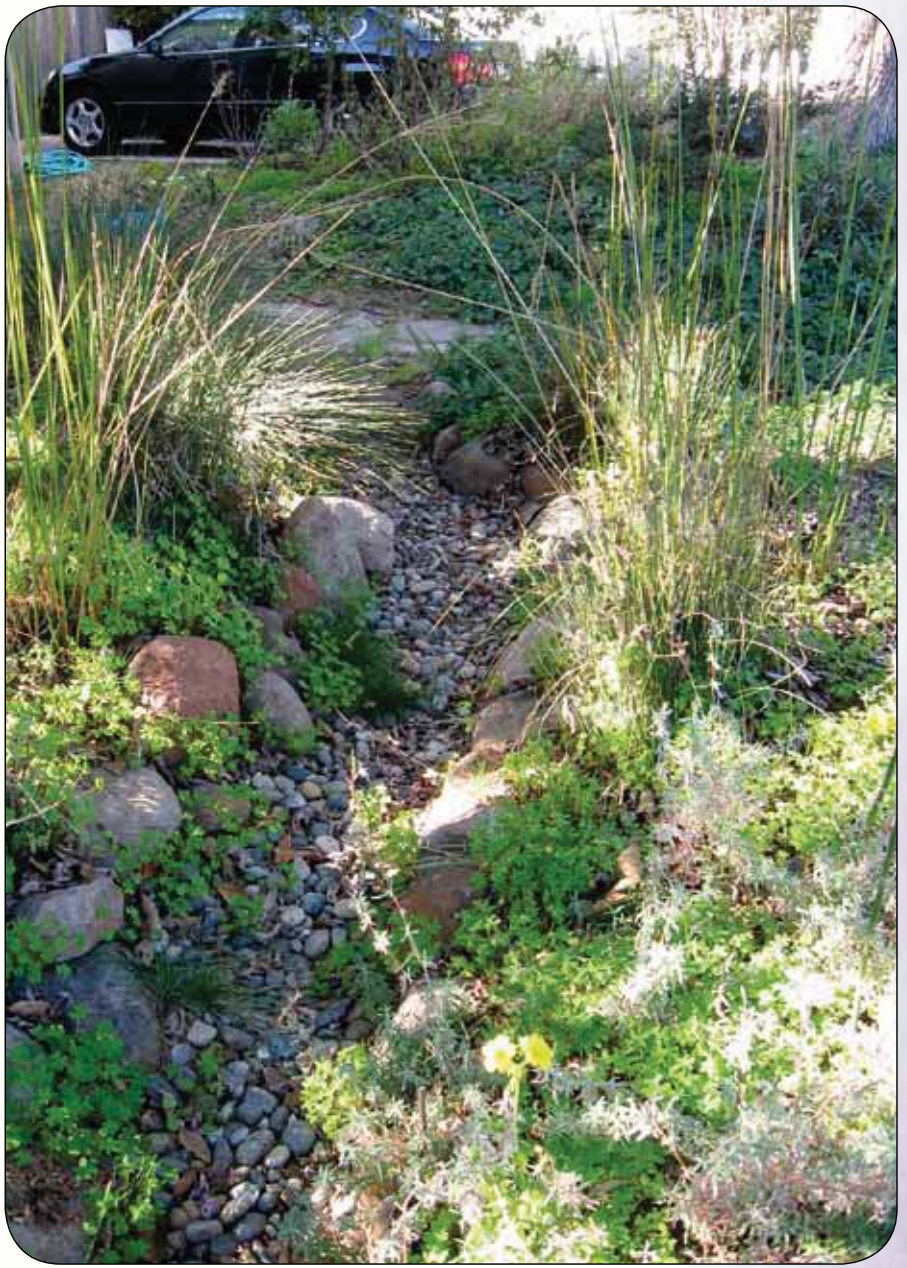


ROCK-LINED SWALES (DRY CREEK BEDS)

A rock-lined swale (or dry creek bed) uses rock instead of grass or other vegetation to safely infiltrate and convey runoff. Most are designed coarse rock in the channel for more surface area and topped with rounded rock on the surface for an aesthetically pleasing landscape feature that mimics a creek bed.

When installing a swale use a minimum 2% slope from beginning to end (longitudinal slope) to ensure that water is conveyed away from any structures and to a desired destination. Non-woven geotextile fabric can be used underneath the rock.

MAINTENANCE: Periodically remove leaves and replace rocks moved by surface flow.



DO

- Use existing rock from your property if available.
- Use washed rock from a local quarry.
- Make sure the outlet does not cause erosion or clog
- Use non-woven geotextile fabric beneath the rock.

DON'T

- Install in soils with high water tables or saturated clay soils without an overflow device.
- Place too close to your home's foundation.
- Allow leaf litter to accumulate.

Pervious Hardscapes

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USES: WALKWAYS, PATIOS, PARKING AREAS AND DRIVEWAYS

There are many new types of pervious materials that allow runoff to pass through and **SINK** back into the soil. Some popular choices are paver stones, turf block and permeable asphalts and pavements. There are now pervious options for almost any application. Since the variety of options is growing rapidly, we will only discuss them generally. For specifics on installation and use, contact your local retailer or product manufacturer.

PAVER STONES/FLAG STONES

Paver stones are normally made of pre-cast brick, concrete, stone or other material and installed over a sand base. They come in various shapes and normally interlock and can form different shapes and patterns. Pervious pavers are designed to allow more runoff to SINK into the ground than traditional pavers. Each paver has a spacer that ensure the ideal distance between placed stones for maximum infiltration. Flag stones are larger and may be placed directly on the soil. A low-growing ground cover may be planted between flag stones to allow for greater infiltration. Pavers can be used in high use area such as parking lots, patios and walkways.

MAINTENANCE: Keep the area clear of sediment to prevent clogging. Annual vacuum sweeping with a shop vac helps maintain permeability. The gaps between pavers may require occasional weeding or scorching and sand or gravel replenishment. Because pervious pavers are easily lifted and reset, they are easy to repair or replace.

DO

- Use only in gravelly sand, loamy sand or other pervious native soils.
- Plant vegetation in between or around pavers.

DON'T

- Use in areas with high sediment loads that can clog porous areas.

TURF BLOCK

Turf block (concrete blocks with holes) and similar products can be filled with sand or planted. They provide soil stability for driveways and walkways. Sometimes the pores are filled with gravel or cobble. They are not ideal for everyday parking, because of irrigation and maintenance demands, and if they are planted, long term parking inhibits sunlight required for plant growth.

MAINTENANCE: Planted turf block may require regular mowing (depending on plant choices) as well as irrigation, fertilization and weeding.

DO

- Choose low water grasses such as native fescues.
- Use only in gravelly sand, loamy sand or other pervious soils.

DON'T

- Use in high traffic areas or permanent parking areas.
- Aerate.

PERVIOUS PAVEMENT

Pervious pavements contain pore spaces that allow infiltration of runoff. The water seeps through the material to a rock base layer underneath and is naturally filtered through the underlying soil where pollutants are removed. There are different types of pervious (or porous) pavements including porous asphalt and pervious concrete. Soil must have permeability between 0.5 and 3.0 inches per hour to be considered for pervious concrete installations. The bottom of the rock base/reservoir should be completely flat so that runoff will be able to infiltrate through the entire surface. Pervious pavement should be located a minimum of 2 to 5 feet above the seasonally high groundwater table and at least 100 feet away from drinking water wells. Ideal uses include walkways, residential parking areas, and driveways.

Although installation is becoming easier and a more cost-effective alternative to traditional paving methods, appropriate construction techniques are necessary to ensure the effective performance of pervious pavements. Hiring a licensed contractor experienced in these materials is highly recommended and may even be required depending on the application.

MAINTENANCE: Keep clear of soil, rocks, leaves, and other debris. Vacuuming annually, using a shop vac or specialized vacuum for larger areas, may be necessary to remove debris from the surface of the pavements. Always follow the manufacturer's maintenance recommendations.

DO

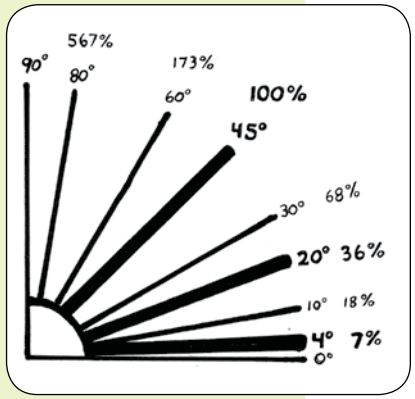
- Consult a professional to recommend a design customized to your site.
- Treat surrounding bare soil areas by planting or mulching.

DON'T

- Use in areas where there is a possibility of sand drifts.
- Seal or repave with non-porous materials.

DID YOU KNOW?

There is much confusion when referring to the "steepness" of slope. We sometimes find a slope measured in degrees and other times as a percentage such as a 20% slope. To figure out the percentage slope, you would use the rise over run formula. For instance a distance of one foot horizontally with a one foot rise over that distance would give you the formula 1/1 or 100% slope. The equivalent angle or degree would be a 45° angle. The chart below is an easy conversion table to calculate the equivalent % grade to degree of slope.



SLOPE GRADIENT CONVERSION TABLE

Ground Covers

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USES: TEMPORARY AND PERMANENT SOIL COVER, LOW USE WALKWAYS, AND SLOPE PROTECTION

Using mulches or vegetation to cover bare soil is a key ingredient to **SLOWING** down and thus preserving valuable top soil, preventing sediment from being carried downstream, and reducing the potential for erosion. Ground cover varieties include vegetation, wood chip, gravel, or other mulches. Mulches are a good choice for areas with LESS THAN a 33% slope. Vegetation works well on areas with LESS THAN a 50% slope.

MULCH (ROCK, WOOD CHIPS, OR OTHER MATERIALS)

Mulching is a simple and beneficial conservation practice you can use in your yard. Mulch is simply a protective layer of material that is spread on top of the soil. Mulches can be organic -- such as grass clippings, straw, bark chips, and similar materials -- or inorganic -- such as stones, brick chips, and recycled glass. Mulching has many benefits such as protecting soil from erosion, reducing compaction from the impact of heavy rains, conserving soil moisture, maintaining an even soil temperature, and preventing weed growth. It is also useful as temporary ground cover until supplemental vegetation becomes established.

MAINTENANCE: Organic mulch may need to be replaced annually. Removal of old mulch and plant debris each fall prevents growth of fungus and other unwanted pests and diseases. Keep any organic materials at least 6 inches from building siding. Gravel or rock should be raked regularly to prevent the buildup of organic materials.

DO

- Use recycled material whenever possible.
- Keep rock free of organic materials.

DON'T

- Use wood chips from diseased trees.
- Use straw mulch near stream channels.

VEGETATION/PLANTING

Plants cover and protect the soil. Once established, plants provide excellent long-term erosion control. Their roots knit together to hold the soil in place. Their leaves, needles and twigs reduce the impact of rain, and the organic matter they add to the soil improves water infiltration. A drip irrigation system provides slow delivery of water to plants, so water infiltrates with little or no runoff.

When selecting plants for a landscape, it is important to understand the site conditions. While most property owners select plant materials for their form and color, it is essential to know their solar, soil, and moisture requirements. Plants that do well in specific microclimates on a site are termed "site appropriate." For the purpose of improving stormwater runoff choose plants that improve infiltration, decrease runoff, filter pollutants, and help stabilize slopes. Contact the RCD (page 55) or a local plant nursery knowledgeable in native and drought tolerant species best suited for these functions.

Native plants (vegetation that grows naturally in particular climates or regions) are a great choice because of their performance, site enhancement, and life cycle cost benefits. Native plants typically are more cost-effective in the long run because they require less water and fertilizer, and they are more resistant to local pests and diseases than nonnative ornamentals. Costs are also reduced due to lower maintenance and replanting requirements. Additionally, native plants provide habitat for local/regional wildlife. If you choose nonnative plants, care should be taken to not plant invasive species as they tend to crowd out the native species. Contact the RCD (see page 55) for a list of plants that should be avoided.

MAINTENANCE: Routine maintenance is required and can be performed as part of the regular landscaping program. Weeding and irrigation are essential in the first couple of months while plants become established. Annual pruning and mulching are recommended. Additional irrigation may be necessary during drought years. The use of native, site-appropriate vegetation reduces the need for fertilizers, pesticides, excessive water, and overall maintenance requirements.

DO

- Use California natives or drought tolerant plants that can endure periods of saturation.
- Keep plants well pruned near foundations and siding to allow adequate ventilation.
- Minimize fertilization or try organic options to prevent water contamination.

DON'T

- Plant invasive species such as periwinkle (Vinca) or certain ivys.
- Plant highly flammable vegetation near buildings.
- Allow irrigation water to drain to your driveway, the street, or bare soils.

Erosion Control Blankets (ECBs)

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USES: BARE SOIL COVER AND SLOPE PROTECTION WHILE ESTABLISHING VEGETATION

Erosion control blankets are a good tool to improve the success rate of new plantings and can quickly add a layer of protection to bare soils. Some of the benefits of ECBs include reducing seed and soil loss, decreasing runoff volume and velocity, reducing top soil disturbance and loss, encouraging plant root developments and suppressing weeds.

It's important to choose the correct ECB for the site conditions (slope, runoff velocity, and purpose). Ask your local retailer or contact the RCD for assistance (see page 55) in choosing the correct blanket. We have included basic installation instructions, but ALWAYS follow the manufacturer's recommendations.

Before laying the blanket, prepare the soil surface making sure it is smooth to maximize soil-blanket contact. At the top of the slope, at least 2 feet from the crest, dig a 6" minimum ditch (called an anchor ditch). Line the ditch with the top of the ECB leaving enough to roll back over once the ditch is filled. Now fill the ditch back in over the ECB and wrap the extra over the top and secure with staples. Next, carefully roll the ECB vertically down the slope in the same direction as the water flows. Overlap the side edges of the contiguous blankets used by at least 4" and overlap the top and bottom edges of the blankets by at least 3". The uphill roll should overlie the downhill roll. Stake the blanket, at a minimum, horizontally every 2 feet and vertically every 3 feet. Stake at least every foot where an uphill and downhill blanket overlap. If the ground is soft, staples can be used to hold the blanket down. Otherwise, 4" nails and a washer should be used.

MAINTENANCE: Monitor for erosion until vegetation becomes established. Check for proper placement that could be disturbed by animals or a large storm event. Ensure that overlaps remain in place and correct as necessary.

DO

- Make sure to choose the appropriate ECB for the desired use and conditions.
- Use decomposable netting.

DON'T

- Walk on the ECB after it is place.
- Allow gaps between the blanket and the soil.
- Let concentrated runoff flow onto the ECB from above.

Cross Drains

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USES: DRIVEWAYS, PRIVATE ROADS

Cross drains are used to **SLOW** water down by breaking up the impervious surface area into smaller sections. Smaller sections help divert the water to a point where it can **SINK** in to help combat the ill effects of driveway and road runoff. The BMPs described here can be installed on existing driveways and roads, both paved and unpaved. If you are constructing or reconstructing a road, other techniques such as outsloping can be used but are beyond the scope of this guide. Contact the RCD for a free copy of the Private Roads Maintenance Guide for more information on alternative techniques. See page 55 for contact information.

WATERBARS

Waterbars are used to break up runoff into small units so that it does not have enough energy to erode soils. They also divert water away from streets and allow it to infiltrate. On unpaved roads, an earthen waterbar, also known as a water break, consists of a shallow trench with a parallel berm or ridge on the downslope side which is angled down across the road. On these surfaces they can be constructed by hand, with a backhoe, or with a blade-equipped tractor. Optimal size of an earthen waterbar is 12 inches above the road surface and 6 inches below the road surface. Asphalt or cement waterbars can be smaller in size (6 inches) and thereby provide greater ease of access. Water bars should be installed at a 30 to 45 degree angle and in most cases the outlet of waterbars should be protected with rock dissipaters.

MAINTENANCE: Keep the outlets clear of debris and sediment so water drains freely. Inspect annually and make necessary repairs to earthen berms that break down over time and ensure there is no erosion.

DO

- Install energy dissipators at all outlets.
- Install at 30 to 45 degree angles.

DON'T

- Direct runoff to erodible surfaces.
- Outlet water onto steep slopes.
- Direct water to a neighbor's property.

SLOTTED CHANNEL DRAIN

A slotted drain installed across the width of your driveway is another option to address surface runoff. It consists of a metal-grated conveyance structure that transports water to a safe location. Decorative varieties are also available. Slotted channel drains are installed flush with the driveway surface, a feature that makes these conveyance devices more appealing for aesthetic reasons. The drain should be sloped no less than a ½ inch per foot of length to prevent clogging from sediment and debris. It should also be angled at 30-45 degrees. Although slotted channel drains may be installed on any driveway, they are recommended for driveways with slopes greater than five percent and free of debris, soil, etc.

MAINTENANCE: Ensure that the grate is open before and during storm events (not covered by leaf litter). Check that the outlet is protected, non-eroding, and clear of debris and sediment so water drains freely.

DO

- Ensure the drain is large enough so that the majority of water enters the drain and doesn't flow over.
- Install energy dissipators at all outlets.
- Install at 30 to 45 degree angles.

DON'T

- Install channel drains in areas with large amounts of leaf debris.
- Outlet water onto steep slopes.
- Direct water to a neighbor's property.

Retaining Walls and Terracing

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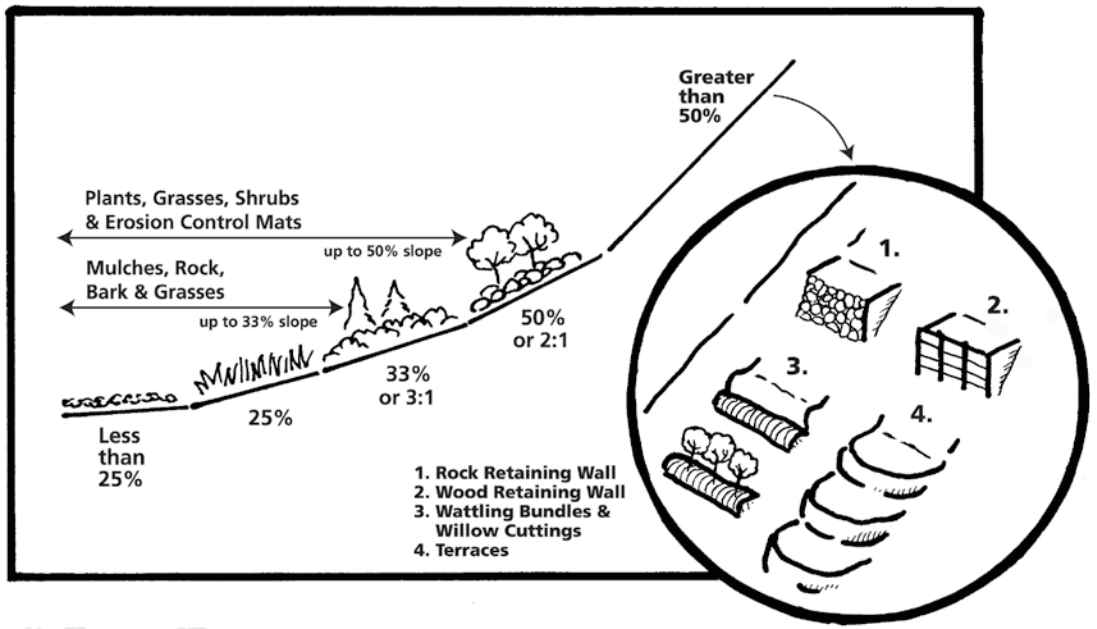
USES: SLOPED AREAS

Protecting steep slopes is very serious! Improperly installed systems can pose a serious threat to life and property. We recommend that ALL retaining wall and terraced areas be designed and installed by a licensed qualified professional.

Retaining walls and terraces are used to reduce the gradient or slope and provide level or gently sloping areas for establishing vegetation. Retaining walls and terrace walls are constructed with boulders, treated timber, bricks and/or interlocking concrete blocks. (Walls over three feet high must be designed by an engineer). There are MANY different types of retaining walls, each with a different purpose, so always check with a qualified professional before embarking on any wall project for soil retention. A building permit and engineering expertise are required to build many retaining walls. Always check with your local planning department to determine if a permit is necessary for your project.



RETAINING WALLS

Rock retaining walls are an alternative to wood retaining walls and are often used next to a roadway or drainage way. They are freestanding walls built from rock 10 inches to 2 feet in diameter. A footing trench is dug along the toe of the slope, and the largest boulders are placed in the trench. Subsequent rocks are laid with at least three bearing points on previously laid rocks. The external face of the wall should incline slightly uphill, though the wall itself is freestanding and does not lean. As the wall is built, fill material is placed around and behind the rocks and packed in. Since the finished slope behind the wall will be flatter than before treatment, possibly a level terrace, it should be easier to establish all-important perennial plants on and above the wall.

Wood retaining walls can be used on slopes steeper than 50 percent and are often located between the base of a slope and an adjacent road, driveway or drainage way. Lumber and posts should be treated with an approved wood preservative (not creosote). Ensure proper drainage methods behind the wall are utilized. As always, vegetation should be established on the slope above the wall.

WILLOW CUTTINGS

Willow cuttings are used under very specific site conditions and are normally recommended only through the guidance of a qualified professional. Contact the RCD for more information (see page 55 for contact information).

TERRACES

Many materials are available for building terraces. Treated wood is easy to work with, blends well with plants, and is often less expensive than other materials. Interlocking concrete blocks are made specifically for walls and terraces and are more easily installed by a homeowner than other materials, such as fieldstone and brick. The steepness of the slope dictates wall height. Make the terraces in your yard high enough so the land between them is close to level. This soil surface should be carefully revegetated. Be sure the terrace material is strong and anchored well to stay in place through cycles of freezing, thawing, and heavy rainstorms. Large terraces should be tied back into the slope and properly drained. This takes expertise and equipment, so you may want to restrict the terraces you build to a foot or two in height. Get help from a professional to make sure higher walls stand up to the forces of gravity and water pressure in the soil.

MAINTENANCE: Always check retaining walls to make sure they are not leaning or failing. Ensure there is adequate drainage behind walls and the drains remain functional.

DO

- Provide adequate drainage behind retaining walls.
- Use a qualified professional to design your wall.

DON'T

- Install without checking on permit requirements.
- Use creosote-treated wood.

DON'T FORGET MAINTENANCE!

Activity	Frequency	Winter	Spring	Summer	Fall	Notes
Gutters and Downspouts						
Clean Gutters	Monthly and after every major storm throughout the rainy season.	■	■		■	Installing gutter guards can reduce maintenance.
Inspect for leaks and repair	Monthly and after every major storm throughout the rainy season.	■	■		■	Leaking gutters can cause damage to your roof and eaves.
Check downspout outlets	After every major storm.	■	■		■	Check for blockages and ensure runoff is routed ways from buildings and structures.
Drip Line Protection						
Replant/prune vegetation	Annually (before the first rain) or more frequently if needed.				■	Replace dead or dying plants. Prune to keep from direct contact with structures.
Replace rock or ground cover	Annually or as needed.			■		Replace rock and mulch to ensure no bare soil is present.
Inspect foundations and structures	Annually.			■		Check for mold or damage to foundations or rot on wood structures. Replace as necessary.
Rain Water Harvesting Systems						
Clean debris from screens	As needed throughout the rainy season	■	■		■	Lead and other debris can clog screens and create undesirable overflow and erosion.
Drain and clean tanks	Annually or as needed				■	Clean accumulated sediment from tanks. A shop vac can be used on large tanks.
Inspect tanks for leaks/cracks	Annually			■	■	Repair or replace as needed.
Inspect plumbing	Annually or as needed				■	Inspect all connections, pumps, and filters.
Swales						
Vegetation management	Annually or as needed		■	■	■	Periodic mowing (keep grass 2-4 inches high), weed control, and reseeding of bare areas.
Debris and sediment removal	Annually or as needed			■	■	Always remove debris that could obstruct the swales function. Remove accumulated sediment as necessary in the summer.
Inspect for erosion and ponding	Throughout the rainy season	■		■	■	Regularly inspect for ponding, gullies, and uniformity in cross section width and longitudinal slope. When the uniformity is compromised it should be corrected quickly.

Activity	Frequency	Winter	Spring	Summer	Fall	Notes
Outlets						
Inspect for erosion	After major storms	■	■		■	Outlets should be checked for erosion and to ensure they are diverted to a safe location.
Pervious Hardscapes						
Sediment and debris removal	Annually and as needed.			■		Vacuum using a shop vac or specialized vacuum using manufactures recommendations. Remove leaf litter.
Groundcovers						
Replace organic mulch and remove old mulch and plant debris	Annually.				■	Organic mulch may need to be replaced annually. Removal of old mulch and plant debris each fall prevents growth of fungus and other unwanted pests and diseases. Keep organic materials at least 6 inches from building siding.
Rake gravel and rock	Regularly.	■	■	■	■	Gravel or rock should be raked regularly to prevent the buildup of organic materials.
Erosion Control Blankets						
Check for movement, placement and proper overlap	Regularly until vegetation becomes established.	■	■	■	■	Monitor for erosion until vegetation becomes established. Check for proper placement that could be disturbed by animals or a large storm event. Ensure that overlaps remain in place and correct as necessary.
Cross Drains						
Check outlets	Regularly during the rainy season.	■	■		■	Keep outlets clear of debris. Earthen berms periodically need to be rebuilt. Remove sediment accumulation on uphill side of berms.
Clear inlets	Regularly during the rainy season.	■	■		■	Ensure slotted drain inlets are clear of debris.
Retaining Walls						
Inspect for failures and proper drainage	Regularly.	■	■	■	■	Always check retaining walls to make sure they are not leaning or failing. Ensure there is adequate drainage behind walls and the drains remain functional.

CHAPTER 3
DIFFICULT SITES AND SITE CONSTRAINTS

There are a wide variety of soil types found in Santa Cruz County. When attempting to implement any BMP that increases the infiltration of water into the soil, it is critical that the soils have the capacity to handle the amount of water being directed to the area. Conducting a thorough analysis of your soils and determining if a BMP will function properly are critical to the long term success of any project. In order to evaluate your soils visit **websoilsurvey.sc.egov.usda.gov**. Be sure to verify that the soil conditions noted on the website are accurate by observing your own soils or by contacting the RCD or a qualified professional. Also make sure to look for areas of shallow parent material or infiltration limiting layers such as hardpans. These areas may required engineering for proper function fo BMPs.

Frequently, site conditions make it difficult or impossible to implement certain home drainage practices. For example, sites that are on steep slopes, located in a wet area with a high water table, or soil conditions that have poor infiltration rates can be problematic. Below is a list of primary site constraints that you should consider when evaluating drainage practices for your home. Although there are many opportunities to control runoff on site, it is important to consult a professional to ensure that all options are thoroughly considered and to avoid unforeseen consequences.

STEEP SLOPES

The steepness of slope plays a significant role in determining the practices that can be installed. Avoid installing practices on slopes that are greater than 50% without professional consultation. Use caution when installing practices on any steep slopes. By directing and infiltrating runoff to these sites you run the risk of saturating soils and promoting slumping and conditions that promote landslides. Out-letting drainage systems on steep slopes can also cause erosion that can lead to gully formation and even landslides. If your home is on or near steep slopes, please consult an expert before considering home drainage projects.

PREEXISTING EROSION PROBLEMS

In some cases, preexisting erosion problems may complicate the site and preclude the implementation of drainage practices. It is important to be aware of your current erosion issues and be sure that the drainage practices you implement will not make your drainage and erosion issues worse. Of particular importance is ensuring that you do not exacerbate current conditions by diverting flows into already dynamic systems. If your home has existing erosion problems, please consult an expert before considering home drainage projects.

GEOLOGICALLY HAZARDOUS SITES

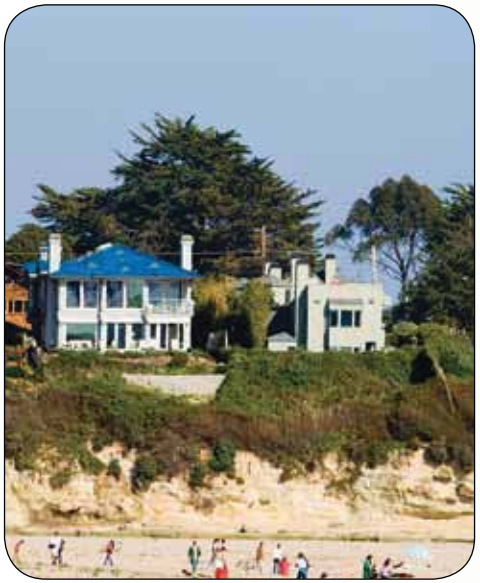
The County of Santa Cruz administers the Geologic Hazards Ordinance. This ordinance identifies areas subject to hazardous conditions and notes these hazards on a series of hazard maps. These maps should be consulted to identify if your home is located within a hazard area. If your home is in one of these areas, please consult an expert before considering home drainage projects.

DID YOU KNOW?

Professionals who specialize in erosion and sediment issues can earn a Certified Professionals in Erosion and Sediment Control (CPESC) certificate.

To receive CPESC certification, an applicant must have successfully passed a written examination designed to determine proficiency in the principles, practices, and legislation of erosion and sediment control. A CPESC must also have either 1) earned a High School Diploma (or equivalent) and had seven years or more of professional level experience in the erosion and sediment control profession OR 2) earned a qualifying BS degree or higher and had three years of professional level experience in the soil erosion and sediment control profession.

To find a CPESC in your area, visit www.cpesc.org.



COASTAL BLUFFS

Coastal bluffs are inherently geologically unstable and prone to erosion. You should avoid placing any additional drainage on these sites whenever possible. Careful management of site drainage is probably the most cost-effective approach to minimizing bluff hazards. Even where circumstances dictate significant structural stabilization efforts, such as shoreline bulk heading or re-grading of slopes, site drainage remains an essential component of the solution. Consult a drainage professional when designing drainage system for sites on coastal bluffs.

AREAS PRONE TO FLOODING

Under a widespread heavy rain scenario (accumulation of .30 inches of rain per hour or more), severe flooding is likely in low-lying areas within a basin. Based on the 100-year flood plain (FEMA Zone A), 11% of the developed parcels (8,359) and 5% of the roads (103 miles) within Santa Cruz County are located within or intersected by the 100-year flood plain. If your home is within a flood prone area, please consult an expert before considering home drainage projects.

LANDSLIDE ZONES

Santa Cruz County is extremely susceptible to landslides due to the topography and geological soil characteristics. Based on GIS survey analysis 7.5% of the developed parcels (5,523) and 11% of roads (233 miles) are within or intersected by known landslide-prone areas. Installing complex drainage practices that promote infiltration may also promote landslide activity if hill slopes become saturated. Designing drainage practices on these sites requires special care. To determine if your home is in a landslide area, consult the potential landslide area map that can be found on the County of Santa Cruz Web site. If it is located in a landslide zone please consult an expert before considering home drainage projects.

CHAPTER 4
LOCAL PROJECTS

This sections contains example of both residential and small commercial projects installed throughout the Monterey Bay area that incorporate the Best Management Practices (BMPs) outlined in this guide. To further incentive home and business owners to integrate watershed friendly practices into their landscapes, the Monterey Bay Friendly Landscaping & Gardening (MBFL) programs were developed in a collaborative effort between Ecology Action, California Landscape Contractors Association (Central Coast Chapter), Ecological Landscaping Association, Monterey Bay Master Gardeners, Surfrider Foundation, Resource Conservation Districts, and more than 20 public agencies representing water utilities, solid waste and recycling and stormwater management. The programs offers benefits such as discounts at local retailers and public recognition to home and business owners whose landscapes are certified as MBFL. You can also find listings for free and low-cost how-to workshops, rebates for adding BMPs to your property, and a list of trained Green Gardeners to help with all of your landscape needs. Certified Monterey Bay Friendly Landscaping projects are identified with the MBFL logo. You can also look around town for additional certified landscapes displaying the MBFL yard sign. For more information on the programs, visit **www.green-gardener.org**.

RAINWATER TANKS/NATIVE PLANTS

Location: Live Oak
Designer: Michael Johnson, California H20rticulture Services
Installation: Live Oak Grange members

Project Description: In 2014, the Grange installed the **first rainwater collection system for toilet flushing on a commercial building in Santa Cruz County.** The installation of the 1320 gallon cistern gave the Grange the opportunity to re-landscape the front of the property with fast growing California native shrubs like Flannel Bush and Ceanothus that shade the cistern, and a rain garden to infiltrate overflow from the cistern into the landscape. The Grange also has a smaller rainwater harvesting collection system made from recycled barrels that provides water for chickens.

PERVIOUS WALKWAY/RAIN BARREL

Location: Capitola
Designer: Michael Arnone + Associates,
Jennifer Colfer, Landscape Architect
Installation: Kurt Christenson, Landscape Contractor

Project Description: This complete redesign included removal of concrete that was replaced with gravel and flagstone paths and patios. Downspouts are diverted to vegetated areas and rain barrels. The homeowner received rebates from the water district for both lawn removal and rain barrel installation.

BIORETENTION/DRY CREEK BED

Location: Santa Cruz
Designer: Michael Arnone + Associates

Project Description: Bioswales disguised as dry creek beds capture all of the roof runoff from the building. Dought tolerant plants require very limited irrigation.

DRY CREEK BED

Location: Aptos
Designer: Nicole W. Douglas/Douglas Landscape Design
Installation: Juan Renteria

Project Description: This project aimed to keep stormwater onsite by redirecting the downspout into a dry creek bed. Project was installed immediately prior to large rainstorms in December 2014 and it functioned beautifully; all water was recharged into ground before reaching the driveway. This project received both a turf removal and downspout disconnect rebate from the Soquel Creek Water District.

RAINWATER CATCHMENT

Location: Scotts Valley
Designer: Earthcraft Landscape Design
Installation: Superior Pump Company

Project Description: This is a 30,000-gallon rainwater harvesting system that has reduced erosion, sedimentation, and peak flows into Granite Creek. It has also increased aquifer recharge and will provide for the owner's annual irrigation (drought tolerant plantings, large organic vegetable garden and orchard, etc.)

RAIN GARDEN/DRY CREEK BED

Location: Santa Cruz
Designer: Love's Gardens
Installation: Love's Gardens

Project Description: The rain garden and dry creek bed stopped flooding of the front path to the house and now keep water on-site. Runoff infiltrates and is stored in the soil for later use by drought tolerant plants and no longer carries potential pollutants from the street to the Monterey Bay.

BIORETENTION POND/RAIN GARDEN

Location: Watsonville
Designer: Ausonio Incorporated of Castroville

Project Description: The bioretention pond treats runoff and reduces peak flows from a small parking area at Smith and Vandiver, a company in Watsonville that makes and distributes shower, bath, and body care products.

VEGETATED SWALE/BIORETENTION

Location: Santa Cruz
Designer: Ifland Engineers, Inc.
Installation: Durden Construction and Leonard Yee (Landscaping)

Project Description: This small commercial project includes a parking lot with curb openings to allow stormwater runoff to enter into a biofiltration swale in the landscape island between rows of parking. Another swale directs runoff from the parking lot to a raingarden near the intersection with Madrone Street. Together, these features provide treatment of stormwater runoff prior to its discharge from the site to the public storm drain system. Prior to the project, the site was completely covered in impervious surfaces with no treatment or detention.

PERVIOUS HARDSCAPES

Location: Aptos
Designer: Ifland Engineers
Installation: DEVCON Construction

Project Description: Construction of a new office building and associated parking for CFSCC. The building was cut into the naturally sloping hillside to minimize the appearance of total building height and required grading. Pervious concrete was utilized in parking spaces to encourage groundwater recharge. In addition, rock-filled drilled shafts were installed under pervious concrete parking at the low end of the site to further promote infiltration. Only the overflow from more severe storm events is intended to be released from the site.

DRY CREEK BED

Location: Pacific Grove
Designer: Oona Johnsen, Landscape Architect
Maintenance: Native Sun Landscapes

Project Description: The lawn was removed and the downspouts were directed to the newly installed dry creek bed to allow for infiltration of the roof runoff and reduce the volume of runoff to the sidewalk and the street.

SWALE/PREVIOUS HARDSCAPE

Location: Santa Cruz
Designer: Love's Gardens
Installation: Love's Gardens

Project Description: The original impervious concrete path was removed, and the pieces were used to create an urbanite path that allows water to infiltrate. Water that was draining to the street is now diverted to the path and into the landscape (see flexible black pipe extending from the soil bed at the start of the path). The use of native, drought tolerant plants in combination with the extra water now stored in the soil allowed the irrigation system to be removed thus conserving more water. All of these practices support cleaner water and reduced flooding by limiting runoff leaving the site.

UNDERGROUND WATER STORAGE/GROUNDCOVER

Location: Santa Cruz
Designer: Habitat Gardens
Installation: Habitat Gardens

Project Description: This rainwater storage system collects rainwater from two downspouts on the front of the house. The water passes through a debris filter and then into a 3,000-gallon underground water storage cistern. The water is used to irrigate the landscape providing nutrient-rich water to vegetation and local wildlife, as opposed to commercially treated water that can contain chlorine and other additives. The overflow from the cistern empties into the seasonal pond located on top of the cistern to allow for more rainwater storage. When the seasonal pond is full, it overflows down a seasonal creek bed or rock swale. The runoff that eventually makes its way to the street has been significantly reduced though infiltration.

GROUND COVERS/EROSION CONTROL BLANKETS

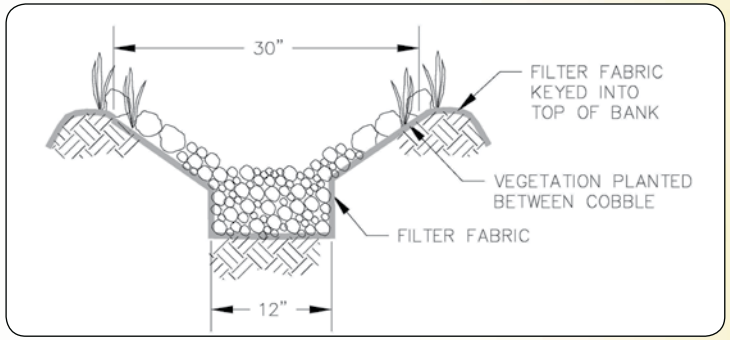
Location: Santa Cruz
Designer: Habitat Gardens
Installation: Habitat Gardens

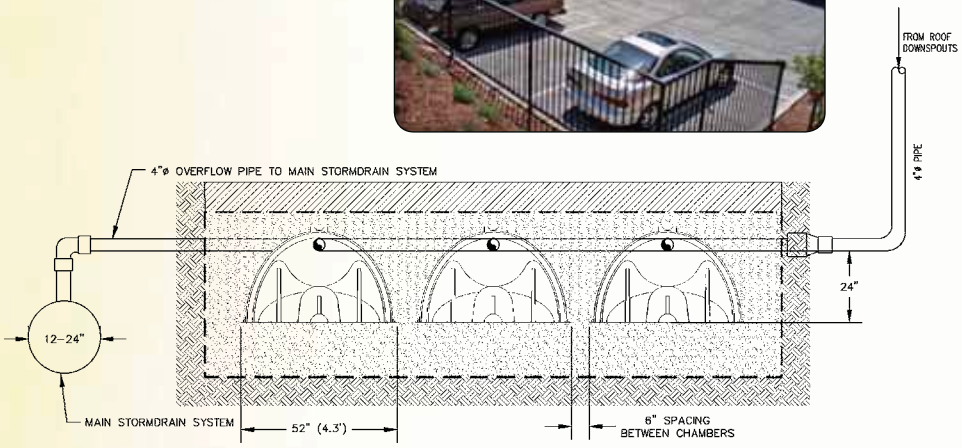
Project Description: This project used jute netting to help control erosion until the plants were established. Mexican Sage and jute netting covered with shredded redwood bark were used.

SWALE/BIOFILTER

Location: Soquel
Designer: Fall Creek Engineering
Installation: Homeowner

Project Description: The owner wanted to incorporate green stormwater techniques for the new ADU (Accessory Dwelling Unit or studio) roof as well as the existing house. As part of this project the driveway was replaced with pervious pavers. Runoff overflow from the pervious pavers, the existing house roof, and the new ADU roof were all directed towards a long dry swale/biofilter. This swale serves as an all weather pathway into the backyard and as a stormwater feature. This swale has been effective in reducing runoff from the site through means of infiltration and improves water quality through biofiltration.





PERVIOUS PAVEMENT/STORMWATER TREATMENT SYSTEM

Location: Watsonville
Designer: Fall Creek Engineering
Installation: Johnstone Moyer Inc.

Project Description: Parkhurst Terrace (Parkhurst) is a 5.89-acre parcel located in southern Santa Cruz County that converted an existing recreational vehicle park into a permanent occupancy, affordable residential development. A portion of the runoff was retained on-site using shallow infiltration chambers and porous pavement. Additional drainage from the roads, other paved areas, and from off-site areas was captured and conveyed in a storm sewer system. All site runoff that exits the site passes through a stormwater treatment system, which will serve to remove silt and grease at the lower portion of the system before the water enters the storm drain off-site. The reduction of impervious surfaces area and use of on-site retention systems reduced the discharge rate and volume of runoff that was flowing to the off-site drainage course along Freedom Boulevard.

GROUND COVERS

Location: Santa Cruz
Designer: Love's Gardens
Installation: Love's Gardens

Project Description: This small patio area is made of urbanite (broken concrete from the site) and recycled tumbled glass. It increases the pervious area and allows water to infiltrate.

DRY CREEK BEDS/RAINWATER CATCHMENT/ DRIVEWAY STRIP/WATER-WISE PLANTS

Location: Capitola
Designer: Raison Cain and Habitat Gardens
Installation: Creative Landscapes and Habitat Gardens

Project Description: This landscape is primarily a California native and edible landscape. There is a large rainwater-harvesting tank in the backyard that feeds the drip irrigation, vegetable bed, and garden hose. There are two drive strips in the driveway to reduce the need for concrete and allow California native grasses to grow in the center of the strip.

There are two seasonal creek beds or rock swales that collect rainwater from the downspouts to help mitigate stormwater runoff. The creek beds are lined with plants that help filter and slow down the water before it leaves the property. One of the rock areas that captures runoff is three feet deep and filled with cobble. This extra depth allows for more stormwater mitigation and percolation.

RAINWATER CATCHMENT/RAIN GARDENS/ DETENTION BASINS

Location: Soquel
Designer: Michael Arnone + Associates, Jennifer Colfer, Landscape Architect
Installation: Prime Landscape

Project Description: The Resource Conservation District secured funding through the State Water Resources Control Board from an EPA non-point source grant to help install this landscape at the Soquel Creek Water District headquarters. Roof runoff is collected in a 2850 gallon cistern and used for irrigation. A rain garden and under ground detention system capture additional runoff that infiltrates back into the ground and reduced overflow to the parking lot.

DRY CREEK BED/WATER-WISE PLANTS

Location: Marina
Designer: Paul Lord - Marina Coast Water District

Project Description: The Marina Coast Water District's Water-wise Landscape Demonstration Garden was created from an old abandoned lot into a vibrant public space that motivates community members to practice and learn more about water-wise garden design principles and practices. It is located in front of the Marina Coast Water District offices at 2840 4th Ave in Marina. Guests are asked to visit the garden during business hours, 8am -5pm on Monday -Thursday.

RAINWATER CATCHMENT

Location: Seaside
Designer: GLS Landscape

Project Description: Chartwell is the first LEED platinum school built in the United States. Visitors, staff and students at Chartwell enjoy day-lit classrooms with carefully planned window systems that reduce the need for electricity by 50%, a roof that reduces heat and **catches rainwater for toilet flushing**, microfans and air quality sensors in classrooms that take advantage of naturally occurring convection currents (this eliminates the ambient noise of other ventilation ducting systems), and an athletic field with infrastructure for recycled irrigation water. By simply moving through the thoughtfully designed series of courtyards, trails, recreation and gathering places, students, faculty, families and visiting community members will know a sense of place that causes us to belong, to take ownership and to care.

SWALES/BIORETENTION/PERVIOUS HARDSCAPES

Location: Soquel
Designer: SSA Landscape Design Architects Incorporated
Installation: QLM Inc. General Engineering Contractor

Project Description: The Heart of Soquel Park and Parking improvement project is located in Soquel Village and borders a potion of Soquel Creek. The project includes a walkway along the top bank of Soquel Creek, a community open plaza and other open space, better visual, pedestrian, bicycle and vehicular access into this portion of Soquel Village from Porter Street and Soquel Drive. The project incorporates best management practices and Low Impact Development stormwater practices such as rain gardens, permeable surfaces and riparian restoration to improve water quality and natural habitat.

DRY CREEK BED

Location: Capitola
Designer: Max Spooner and Sean Wilson
Installation: Max Spooner and Sean Wilson

Project Description: The landowners removed their thirsty lawn and added a beautiful dry creek bed. The downspouts that were previously routed to the street are now directed into the creek bed to allow the water to infiltrate back into the ground. This project also received a lawn removal rebate from the Soquel Creek Water District

PERVIOUS HARDSCAPE DRIVEWAY/ WATER-WISE PLANTS

Location: Santa Cruz
Designer: Habitat Gardens
Installation: Habitat Gardens

Project Description: The concrete driveway was removed along with the existing lawns in both the front and backyard. Broken pieces of concrete from the driveway were used to make flagstone-like pathways and a small patio. The concrete was stained with environmentally friendly iron sulfate to give it a warm, rusty flagstone color. The new driveway is made of two pervious, turf block drive strips with thyme growing out of the turf blocks and in between the cracks of the stepping-stones. Thyme is planted in between all the stepping-stones, and the rest of landscape is very drought resistant with a wonderful mix of Mediterranean plants, succulents, California native plants, edible plants, and one fruit tree.

RESOURCE GUIDE

Copies of this guide are available online at:
www.rcdsantacruz.org or
www.green-gardener.org

Hard copies can be obtained through the organizations marked with an 💧.

American Rainwater Catchment Systems Association
www.arcsa.org

California Landscape Contractors Association
www.clca.org

California Native Plant Society (Santa Cruz Chapter)
www.cruzcnps.org

Central Coast Greywater Alliance
centralcoastgreywater.org

Central Coast Low Impact Development Initiative
www.centralcoastlidi.org

Certified Professionals in Erosion and Sediment Control
www.cpesc.org

💧 **City of Pacific Grove; Planning Department**
300 Forest Avenue
Pacific Grove, CA 93950
(831) 648-3183
cityofpacificgrove.org

💧 **City of Santa Cruz; Public Works Department**
809 Center Street, Room 201
Santa Cruz, California 95060
(831) 420-5160
www.cityofsantacruz.com

💧 **City of Watsonville**
Customer Services
320 Harvest Drive
Watsonville CA 95076
(831) 768 3133

Coastal Watershed Council
(831) 464-9200
www.coastal-watershed.org

💧 **County of Santa Cruz; Public Works Department**
701 Ocean Street #410
Santa Cruz, CA
(831) 454-2160
www.co.santa-cruz.ca.us

Ecology Action
877 Cedar Street #240
Santa Cruz, CA 95061-1188
(831) 426-5925
www.ecoact.org

💧 **Marina Coast Water District**
11 Reservation Road
Marina, CA 93933
(831) 384-6131
www.mcwd.org

Monterey Bay Friendly Landscaping
www.green-gardener.org

Monterey Bay Green Gardener Program
www.green-gardener.org

💧 **Monterey Regional Stormwater Management Program**
5 Harris Court, Bldg D
Monterey, CA 93940
(831) 645-4621
www.montereysea.org

💧 **Pajaro Valley Water Management Agency**
36 Brennan Street
Watsonville, CA 95076
(831) 722-9292
www.pvwma.dst.ca.us

💧 **Resource Conservation District of Santa Cruz County (RCD)**
820 Bay Avenue, Suite 136
Capitola, CA 95010
(831) 464-2950
www.rcdsantacruz.org

Save Our Shores
(831) 462-5660
www.saveourshores.org

💧 **San Lorenzo Valley Water District**
13060 State Rte 9
Boulder Creek, CA 95006
(831) 338-2153
www.slvwd.com

💧 **Scotts Valley Water District**
2 Civic Center Drive
Scotts Valley, CA 95066
(831) 438-2363
www.svwd.org

💧 **Soquel Creek Water District**
5180 Soquel Drive
Soquel, CA 95073
(831) 475-8500
www.soquelcreekwater.org

Surfrider Foundation
(831) 476-7667
www.surfridersantacruz.org

💧 **USDA-Natural Resources Conservation Service (NRCS)**
820 Bay Avenue, Suite 128
Capitola, CA 95010
(831) 475-1967
www.nrcs.usda.gov

Water Conservation Coalition of Santa Cruz County
www.watersavingtips.org

San Lorenzo Valley Water District

Monterey Bay Friendly Landscaping

Resource Conservation District of Santa Cruz County

City of Santa Cruz

Monterey Regional Stormwater & Education Alliance sea www.montereysea.org

Scotts Valley Water District

Ecology Action

Soquel Creek Water District

The County of Santa Cruz 1850

California Water Boards

City of Watsonville