



# Reduce Your Flood Risk

## A Resource Guide

Revised December 2019



**Flood Control District of Maricopa County**

2801 W. Durango Street, Phoenix, AZ 85009 | 602-506-1501

[www.maricopa.gov/floodcontrol](http://www.maricopa.gov/floodcontrol)

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# 1. Purpose of the Resource Guide

The Flood Control District of Maricopa County (FCD) has developed this resource guide to help address commonly-asked questions about flood hazards and floodplain management. Multiple towns, cities and agencies may be responsible for addressing local drainage and flood problems, and regulating development in floodplains. It can be confusing for the public to understand who to contact to answer questions and concerns. This guide will help direct you to the right organization for your particular situation. In addition, the guide provides information about flood risk and steps residents can take to reduce their risk.

## 1.2 Helpful Contacts

### A. Flood Control District of Maricopa County

**If you own a property or business in unincorporated Maricopa County or one of the following jurisdictions:** Buckeye, Carefree, Cave Creek, Chandler, El Mirage, Gila Bend, Guadalupe, Litchfield Park, Mesa, Queen Creek, Surprise, Tolleson, Wickenburg, and Youngtown, and need general information or assistance with drainage, flooding, floodplain, or permitting items, violations, or site visits, contact:

General information/main number	602-506-1501
Report an issue with operations / maintenance of flood control structure	602-506-1501
Public information	602-506-6762
Flooding issues	602-506-2419
Drainage complaints	602-506-3301
Floodplain information, determination, permits, violations	602-506-2419
Citizen advocate – assistance with unresolved concerns	602-372-1176
Website	<a href="http://www.maricopa.gov/FloodControl">www.maricopa.gov/FloodControl</a>

### B. Maricopa County Department of Transportation (MCDOT)

For information about County-owned roads, to report flooding or other hazards on County roads, or to see the locations of road closures in Maricopa County, contact:

General information/main number	602-506-8600
Report road hazards	602-506-6063
Road closure information	<a href="http://www.maricopa.gov/Transportation">www.maricopa.gov/Transportation</a> (services)

### B. Maricopa County Planning & Development Department (P&D)

For information about building permits, drainage review and clearance, or site visits in Maricopa County, contact:

General information/main number	602-506-3301
Website	<a href="http://www.maricopa.gov/Planning">www.maricopa.gov/Planning</a>

### C. Flood Monitoring and Reporting

Real-time rainfall & stream flow data	<a href="http://www.maricopa.gov/625/Rainfall-Data">www.maricopa.gov/625/Rainfall-Data</a>
Arizona flood warning	<a href="http://www.afws2.org">www.afws2.org</a>
Maricopa County Emergency Management	<a href="http://www.maricopa.gov/999/Emergency-Management">www.maricopa.gov/999/Emergency-Management</a>
National Weather Service	<a href="http://www.nws.noaa.gov">www.nws.noaa.gov</a>
View or submit photos of flooding in your neighborhood	<a href="http://www.reportaflood.org">www.reportaflood.org</a>

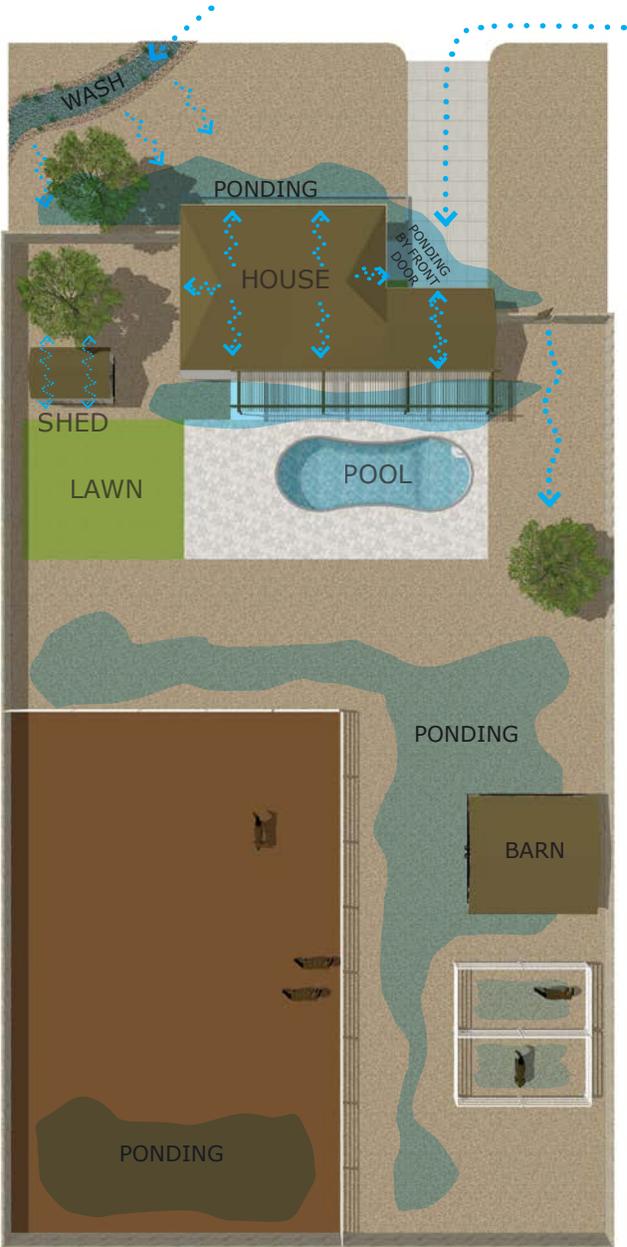
# 1.3 Storm Water Management

## A. Why Can Storm Water Be a Problem?

Flash floods are the number one cause of weather related deaths in the United States. In the Sonoran Desert storms and flooding can strike quickly so it is important to be prepared. Flooding happens rapidly the more there are hard surfaces like sidewalks, roads, roofs, and driveways.

Stormwater quickly collects and begins to move downstream during a rain event and can cause problems when areas become inundated. In the example pictured on the right water is ponding around the house near the front, garage, and back patio. There is also water collecting in the corral and around the barn.

See the *Homeowner's Guide to Stormwater Management Planning* for more information on how to assess the flooding risks on your property and what are some things you can do to reduce your flood risk.

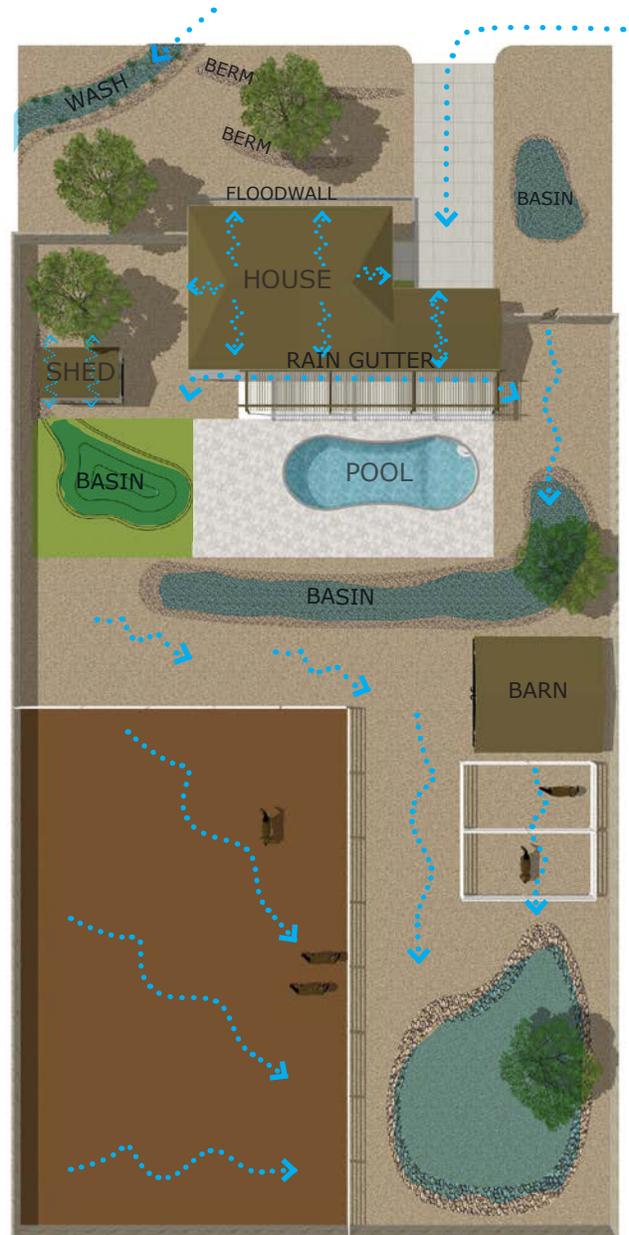


## B. How Can Storm Water Become a Benefit?

Storm water management is the practice of slowing runoff down for it to soak into the ground. With careful planning and some adjustments to your property, stormwater runoff can become an irrigation resource, an aesthetic feature, and can help make your property more resilient to flooding.

The diagram to the right illustrates the flow and collection of the water is spread, slowed, and encouraged to soak in areas that will enhance the landscape rather than collect and potentially cause damage to the property.

See the *Homeowner's Guide to Stormwater Management Planning* for more information on how to assess the flooding risks on your property and some things you can do to reduce your flood risk.



## 1.4 Understand Your Flood Risk

Flooding can occur anywhere in Maricopa County. However, some areas are at a higher flood risk than other areas. These areas are known as floodplains. High risk floodplain areas are known as Special Flood Hazard Areas (SFHA). Knowing your flood risk can help you decide what preventive actions to take.

### A. What is a Floodplain?

Flooding is a natural process that shapes river channels and adjacent lands. Floodplains occur next to washes, rivers, wetlands, lakes, coastal areas, and sometimes man-made features such as canals, berms, roads, or railroads. Flooding occurs when runoff from rain that doesn't soak into the ground or evaporate, collects or flows in low lying areas.

In undeveloped areas, flooding and floodplains provide many positive benefits. When development happens in a floodplain, properties and people can be impacted.

### B. How Are Floodplains Mapped?

There are thousands of miles of floodplains in Maricopa County. Because of the large number of floodplains in the County, not all are currently mapped. Every year, the Flood Control District of Maricopa County develops new or updated floodplain maps in areas where the floodplains haven't been identified or where they may have changed and need updating. These updates are known as floodplain delineation studies. Floodplain delineation involves determining the amount of runoff, using surveying and aerial mapping, and factors such as slope, vegetation, soil composition, and land use, and then uses detailed topographic maps and models to determine the where the water flows, how deep it is and how swiftly it flows.

Delineation studies are used by the Flood Control District and its municipal partners to better manage the floodplain and reduce or prevent flood damage. These studies are also used by FEMA to update the nation's Flood Insurance Rate Maps (FIRMs) for the National Flood Insurance Program (NFIP), which identify the regulatory floodplain and the levels of flood risk to individual properties.

- The **regulatory floodplain** is any mapped area in or near a river, wash, stream or other watercourse or other feature that is inundated by water resulting from a 100-year storm event.

## **C. 100-Year Floods: An Important Measure of Flood Risk**

A flood that has a one percent chance of occurrence in any given year is known as the 100-year flood. FEMA refers to this as the “base flood”.

The term “100-year flood” is commonly misinterpreted to mean “once every 100 years,” which is misleading. An area can experience a 100-year flood several times in the same year or not have one for 200 years. Almost every year someplace in Maricopa County experiences a 100-year flood.

The 100-year flood is an important measure of flood risk because it is the national standard used to identify floodplains, require purchase of flood insurance, determine the need for any man-made flood control structures, and regulate floodplains.

Generally a 100-year storm event in Maricopa County is the equivalent of approximately 4 inches of rainfall in a 24-hour period, depending on the location.

While the 100-year storm provides a benchmark to measure flood hazards, it is important to note flood hazards occur for more and less frequent storms than the 100-year event.

## **D. Why Do Floodplain Maps Change?**

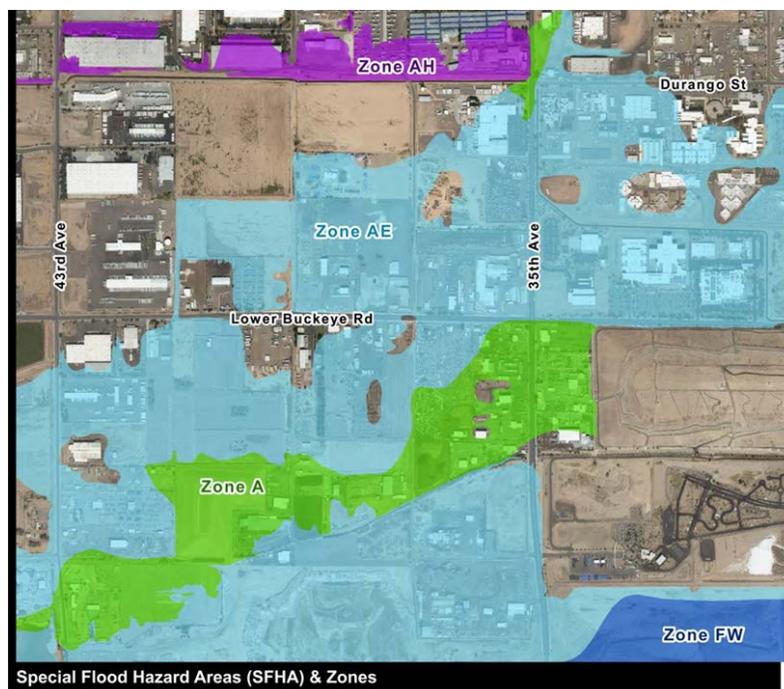
Changing stream patterns, dense vegetation, erosion and land development can affect storm water flow and the areas subject to flooding. In addition, floodplain maps may change because of updated tools and changing FEMA requirements. For these reasons, the FDC periodically updates floodplain maps in watersheds throughout Maricopa County.

## **E. How are Floodplain Maps Used?**

Flood Insurance Rate Maps (FIRMs) are the basis for floodplain management, flood hazard mitigation and insurance ratings. The FIRM is the official map on which FEMA has delineated both the 100-year floodplain and the National Flood Insurance Program (NFIP) flood zone, which help determine the cost of flood insurance. Flood Insurance Rate Maps (FIRMs) depict the designated flood risk for properties as high risk, moderate-to-low risk and undetermined and provide corresponding letter designations to indicate an area’s level of flood risk. The lower the degree of risk is to a property, the lower the flood insurance premium will be. If your property is located in a FEMA floodplain and you have a federally-backed mortgage, your lending institution will require you to purchase flood insurance.

## F. Understanding Floodplain Map Terminology

- **Base Flood** - The height to which floodwater is expected to rise during the base flood—the flood having a one percent chance of being equaled or exceeded in any given year.
- **Floodplain** - Any land area prone to flooding from any source.
- **Floodway** - The channel of a river and the adjacent land areas that must be reserved in order to carry the base flood without increasing flood levels by more than a designated height, usually 1 foot.
- **Flood Insurance Rate Map (FIRM)** – The official FEMA map showing 100-year floodplains and National Flood Insurance Program (NFIP) flood zones.
- **Special Flood Hazard Area (SFHA)** - Land subject to flooding during a base flood where flood hazards are high. This area is where the community's floodplain regulations are enforced and flood insurance is required for mortgage holders. Areas affected by the base flood are shown as Special Flood Hazard Areas (SFHAs) on FEMA flood maps.
- **Zones** - Letter designations that indicate the different types of flood risk or Special Flood Hazard Areas for specific areas. Examples include A, AE, AO, AH and X.



Example of a Flood Insurance Rate Map, which uses letter zones to indicate the level of flood risk in an area

## G. Flood Risk Zones

- Flood Insurance Rate Maps use letters to designate the level of risk to properties in an area.

### High Risk

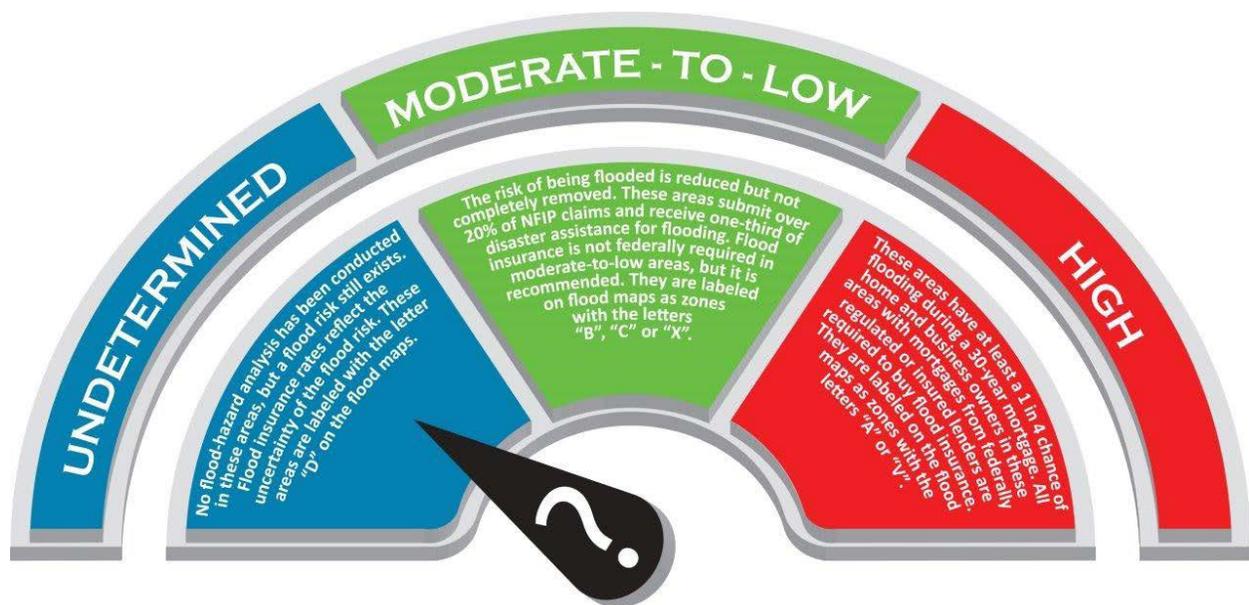
- Zones A and V are the highest risk areas. Residential and commercial properties in these areas have a one in four chance of flooding during a 30-year mortgage. Owners of properties in these zones are required to carry flood insurance if they have a federally-insured mortgage.

### Moderate-to-Low Risk

- In these areas, the risk of flooding is reduced but not completely removed. These are identified as zones B, C or X. Property owners located in these areas submit 20 percent of all flood insurance claims. It is important to note that Maricopa County does not have any V, B, or C zones.

### Undetermined

- In these areas an analysis of the flood risk has not been conducted and an undetermined level of flood risk exists. These areas are identified as zone D.



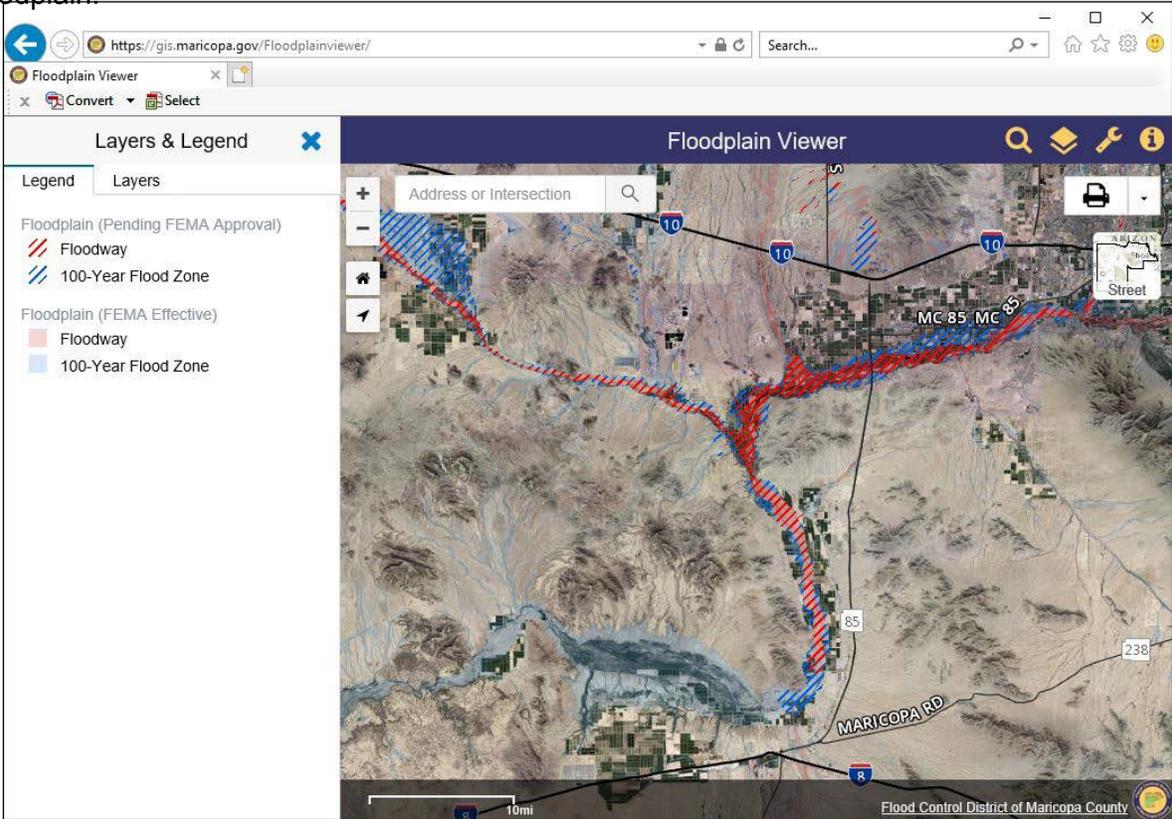
# 1.5 Floodplain Information Sources

## A. Is My Property in a Mapped Floodplain?

One way to determine your flood risk is to find out if you are in a mapped floodplain. You can view online maps on the Flood Control District’s website to determine if your property is located in a 100-year FEMA floodplain at <https://www.maricopa.gov/3942/GIS-Mapping-Applications>. Please note that areas outside of the mapped floodplain should not be interpreted as having no risk of flooding. These online maps are not official documents and cannot be used for floodplain determination.

## B. Why Should I Care?

First, knowing if your property is in a mapped floodplain helps determine your flood risk. Second, if your property is in a floodplain, a floodplain use permit may be required when making changes or constructing improvements on your property (see section 3.4 “Do’s and Don’ts of Floodplain Uses” for more information). Third, if you have a federally-insured mortgage, your lender will require you to purchase flood insurance if your property is within a 100-year floodplain.



You can use Flood Control District’s online Floodplain Viewer to find out if your property is in a floodplain but Flood Control District cannot provide an “official floodplain determination”. . For more information on the floodplain determination for your property, contact Flood Control District or your local jurisdiction’s floodplain manager.

## C. How to Request an Official Floodplain Determination

Flood Control District floodplain representatives can help residents determine whether their property is in a floodplain. This free service is available for property owners anywhere within Maricopa County. For residents within communities that conduct their own floodplain management, Flood Control District staff recommends residents also contact their community's floodplain manager for additional information.

- Call 602-506-2419 and ask for a floodplain representative
- Fill out and return the Flood Control District's Flood Hazard Information Request form

### For floodplain determinations in the following cities, you can also contact:

Avondale	623-333-4218	Paradise Valley	480-348-3693
Fountain Hills	480-816-5100	Peoria	623-773-7210
Gilbert	480-503-6815	Phoenix	602-262-4960
Glendale	623-930-3656	Scottsdale	480-312-2356
Goodyear	623-882-7979	Tempe	480-350-8288

### Additional Sources for Floodplain Information:

- If your lot is in a newer subdivision, the final plat for the community may have the 100-year floodplain limits clearly printed on it.
- FEMA floodplain maps can also be obtained by contacting FEMA at 1-800-336-2627 or going to FEMA's website <https://msc.fema.gov/portal/home>.



Example of a floodplain along New River, Arizona shown here in blue. Often, a floodplain extends for hundreds of feet beyond a wash.

## **D. Challenging or Revising a Floodplain Determination**

It may be possible to challenge the determination or make changes to your house or property that could affect the floodplain determination. There are several processes for this depending on whether you believe your property has been incorrectly mapped in the floodplain or if you are planning to make changes to the property that would reduce your flood risk, such as adding fill to elevate proposed structures on the property.

### **If you disagree with the lender's determination that your property is in a floodplain:**

- **Request a Flood Hazard Determination Review by FEMA**

FEMA will review the information the lender used and issue a letter stating whether they agree with the lender's determination. Your request to FEMA must be postmarked **no later than 45 days** after the lender notifies you of the flood insurance requirement.

### **If you believe your property has been incorrectly mapped:**

- **Request a Letter of Map Amendment (LOMA)**

If your lot or building site is on natural ground higher than the Base Flood Elevation (BFE) shown on the Flood Insurance Rate Map (FIRM), you may request a Letter of Map Amendment (LOMA) from FEMA. A LOMA verifies that your building or portions of your property have been removed from a designated floodplain. This involves submitting an Elevation Form for your property, which may be available from your local floodplain management office for most newer properties. If there isn't a certificate on file you will need to hire a registered land surveyor or engineer to prepare one for you. Homeowners located in an A or AO flood hazard zone can prepare their own.

## 2.0 Reduce Your Flood Risk

There are many steps individuals can take to reduce the flood risk to their property and themselves. First, know what your flood risk is by reviewing the floodplain maps or by contacting the FCD or your local floodplain administrator. Other steps to take to reduce your flood risk include:

- Purchasing flood insurance.
- Maintaining proper drainage on your property.
- Implementing flood-proofing and constructing erosion and other drainage structures.

### 2.1 Purchase Flood Insurance

Purchasing flood insurance does not change the chances of your house getting flooded; however, it does reduce your financial risk due to flooding.

#### A. Why Do I Need It?

- Floods are the most common natural disaster in the United States.
- Flood damage is not covered by homeowners' insurance policies.
- One in four flood insurance claims nationally are for properties in areas outside the mapped FEMA 100-year floodplains.
- Owners whose property is located in a regulated 100-year floodplain are required to purchase flood insurance if they have a federally-backed mortgage.
- You do not need to live near water to be flooded. Every property in Maricopa County is at some risk of flooding, even those located outside floodplains.
- If you get flooded, don't assume federal disaster assistance or other government funds will help you. Federal disaster assistance is available only if the President declares a disaster. Relief funds are a loan that must be paid back with interest.

## B. What Does it Cover?

- Flood insurance covers up to \$250,000 for residential properties and \$500,000 for commercial properties for structural damage.
- Contents coverage to replace furnishings and other valuables must be purchased separately and covers up to \$100,000 for homes and up to \$500,000 for businesses.



## C. How Much Does it Cost?

- Costs for flood insurance vary depending on how much insurance is purchased, what it covers, and the property's flood risk.
- Flood insurance premiums are relatively affordable for homeowners in areas with low to moderate-flood risk– currently less than \$500 per year.
- Flood insurance rates are established nationally and published every April and November in the Flood Insurance Manual by the National Flood Insurance Program (NFIP). Visit to [www.floodsmart.gov](http://www.floodsmart.gov) to calculate your estimated insurance cost and find an insurance agent.
- The rate for an NFIP flood insurance policy will be the same for a particular property regardless of which company issues the policy.

## D. How Do I Purchase It?

- Flood insurance is available to homeowners, renters and commercial owners/renters.
- You can purchase flood insurance through a licensed property insurance agent.
- There is a 30-day waiting period before a flood insurance policy becomes effective, unless the policy is purchased with a new mortgage, with a new loan.

**For more information regarding flood insurance, visit FEMA's Flood Smart website at [www.floodsmart.gov](http://www.floodsmart.gov).**

## 2.2 Maintain Drainage on Your Lot

It is important for property owners to maintain proper drainage on their lot when making changes or improvements. This will help them to avoid potential drainage and flooding problems on their property or their neighbor's property.

### A. Pre-Construction Considerations

Before doing any clearing or preparation of your property for construction keep in mind the following considerations:

- Verify if a permit is required.
- Preserve as much existing native vegetation on your site, as is feasible.
- Minimize “clearing and grubbing” activities and limit the footprint of construction disturbance to preserve the existing vegetation and reduce soil compaction on your site.
- When there are opportunities associated with parcel development or renovations, disturbed slopes should be fine graded so that they are as gentle as possible or terraced to slow down runoff and allow rainwater ample time to infiltrate into the soil.
- Preserve and protect existing topsoil and organic material (deadfall and leaf litter) to improve soil conditions for areas that are targeted for outdoor landscape and re-vegetation projects.
- Rehabilitate disturbed soils during site work activities through the use of soil stabilization techniques that include but are not limited to the use of rock and rip rap materials, native plantings, hydroseeding, and other erosion control techniques and best management practices that help to permanently rehabilitate and restore any disturbed soils.

### B. Post-Construction Considerations

If your site has already been constructed keep in mind the following considerations:

- Observe how stormwater is moving across your property currently and make note of any problem.
- If problems are noted, determine where the water is coming from.

## C. How do I tell if I have a Potential Drainage or Flooding Problem?

Take a quick walk around your lot and start mapping how storm water currently flows through your property. If any of the following conditions exist, you could have a flooding or drainage problem that may cause damage to your home:

- Is any part of the house lower than the surrounding ground such that water cannot flow freely away from the house?
- Is there a natural wash (stream, swale, arroyo, or channel) or man-made drainage channel (ditch) on or near your house or property?
- Is there a storm water storage basin on or by your house or property that needs maintenance?
- Can roof runoff flow safely away from your house?
- Is your property located within a FEMA-mapped floodplain?
- Is there a dedicated drainage easement on or near your house or property?
- Mark down buildings, structures, and areas that have a large amount of hardscape such as driveways or patios.
- Note the locations of downspouts and roof runoff collection.
- Look for evidence of flow (erosion, debris), pooling or ponding (overgrown vegetation, water stained walls), or drainage features (grates, drainpipes) on your property.
- Check for high water marks on your house or property.



Debris deposited by flowing water could indicate a potential drainage or flooding problem.

## D. How can I Determine if Any Floodplains or Easements Drainage Exist on My Property?

- Examine the deed and title to your property for disclosures and restrictions.
- Check the recorded plat for your subdivision or lot for Tracts and Drainage Easements and read their descriptions to understand their purpose and their maintenance responsibility.
- Check the FEMA Flood Insurance Rate Maps for floodplain locations.
- Use your local municipality's website or Records Department to view regulations, maps, aerial photos, records and plans.
- Review the seller's disclosures regarding any drainage and flooding problems on the property.



Water ponds against the fence of a home in north Scottsdale after a storm.

## E. Wash or Drainage Easements

If you have a wash or drainage easements running through your property, local storm water ordinances require you to conduct regular maintenance to maintain the free flow of water in the channel.



Avoid encroaching into the active wash channel

### If you have a wash or stream on your property:

- Avoid crossing washes with walls or fences. Stop walls at the edge of the drainage easement or the channel's floodplain and leave the wash area as open space.
- Avoid crossing washes with your primary access or the only driveway to your house if possible.
- Avoid diverting natural washes from their natural flow path. Local floodplain and storm water ordinances require that runoff should enter and depart from a property in substantially the same manner as under pre-development conditions.
- If you must divert flow within your lot, avoid designing channels that turn the water flow more than 45 degrees.
- **You must not alter a watercourse without approval from your local jurisdiction and certification from a professional engineer** to ensure that any alterations will not increase flood levels or hazards within, upstream or downstream from the altered portion of the watercourse.
- Do not store hazardous materials or other large material that could become debris in or near the wash or floodplain.



Don't store hazardous or large materials that could become debris if washed down a wash or floodplain.

## If I am responsible for maintenance, what should I do?

Maintenance responsibilities for a wash or drainage easement running through your property consist primarily of keeping it free of obstructions to maintain the free flow of water in the wash or channel. Remove trash, debris, sediment, clogging vegetation, obstructions or structures. For more information take a look at the City of Scottsdale's *Homeowner's Guide to Wash Ownership and Maintenance*.

- Washes must not be filled in, plugged, blocked, diverted or altered in any way.
- Trim trees and large shrubs so that limbs are three feet above the bottom of the wash.
- Before removing or trimming vegetation, check to make sure that birds are not nesting in it. In Maricopa County, the nesting season is generally between February and August. *Destroying an active nest is a violation of a federal law such as the Migratory Bird Treaty Act for most bird species in Arizona.*
- Do not remove vegetation that is actively growing on a stream bank. Vegetation in or along a wash may be highly regulated by local, state and federal regulations. Bank vegetation may also provide a level of protection from erosion.
- Invasive species should generally be removed.
- Do not dump or throw anything into washes, ditches or streams. Check and clean grates and inlets on culverts and other inlet structures before the start of each rainy season (May and October), and after large storms.



Owners are responsible for maintaining washes on their property. Keep washes clear of obstructions to maintain the flow of water, but don't remove vegetation growing along banks.

## F. Block Walls and Fences

Block walls and fences can create some of the most serious flooding problems if not installed with proper drainage in mind. Walls or fences should not encroach into any drainage easement including washes.



Wall damaged by flooding.

### Flood Walls:

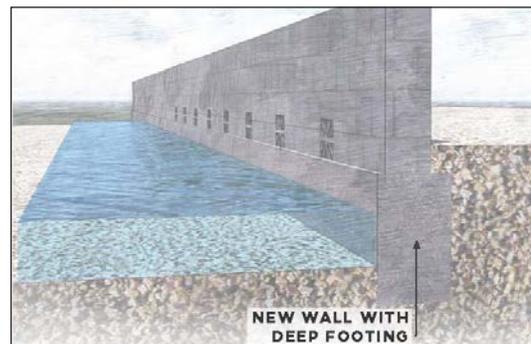
Flood walls are designed to direct flooding away from structures.

#### Benefits:

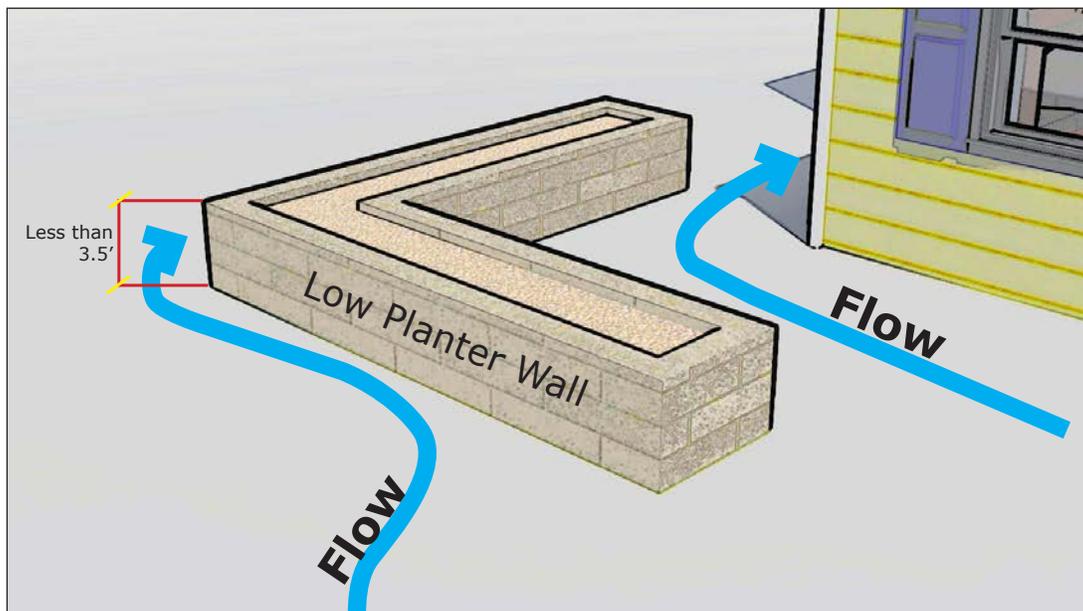
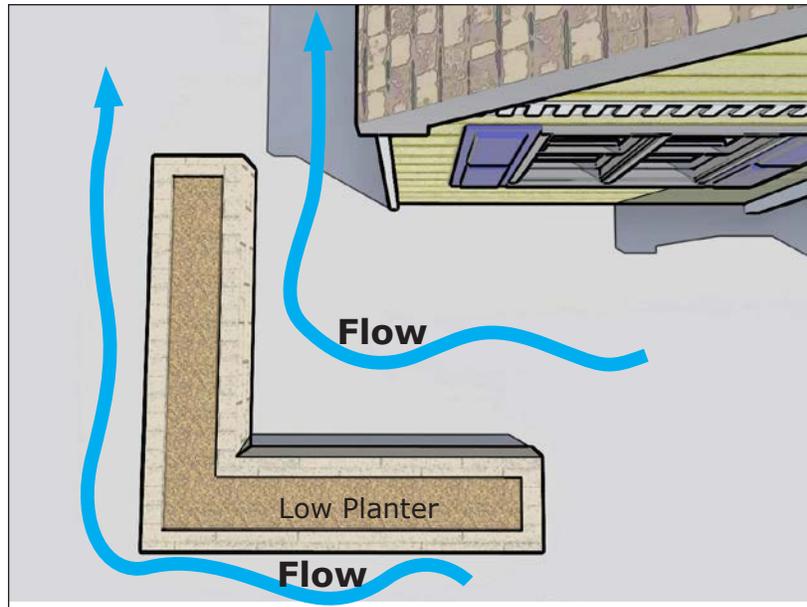
- Effective at diverting runoff from reaching and eroding structures
- Best when used in conjunction with other storm water management techniques

#### Considerations:

- Be sure to check with your municipality or county requirements before constructing
- A floodplain use permit will be needed to construct a wall within a special flood hazard area, drainage easement or floodplain.
- Walls and fences can drastically alter the flow of runoff
- The floodwall should be watertight and should be designed by a design professional and requires a permit
- If you must cross a wash with a block wall or fence, you must maintain a clear, open span for the wash to flow under. If it can't be left open an inclined trash rack should be used to trap debris on the upstream side while still allowing for unobstructed flow. Check with your local municipality for design requirements.
- Construct walls with a large opening; small openings easily catch debris and clog, causing water to pond or to divert. This increases the potential for erosion and can lead to the wall to fail as well as flooding of your neighbor's property.



- Floodwalls don't need to span large areas to be effective. Barriers such as raised planter beds combined with careful grading can help to divert flows away from the base of structures. Arrange these so that they won't trap water on the inside of the barrier and do not divert any washes or concentrated flow.



## Breakaway Walls and Fencing:

Sections of fencing can be designed to break away at strategic locations. When a breakaway segment comes loose it relieves pressure on the adjacent fence sections to allow floodwaters to pass.

### Benefits:

- Creates a safe-to-fail point that is simpler to reset or repair than replacing large segments of damaged fence.

### Considerations:

- Breakaway fencing must meet the design requirements of your local municipality or county.

## Wall and Fence Openings:

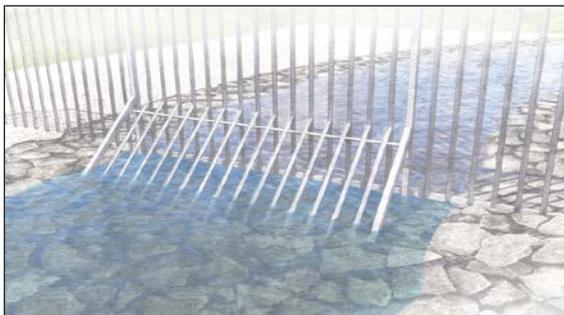
Openings in walls and fences that allow some of the runoff flow to pass through.

### Benefits:

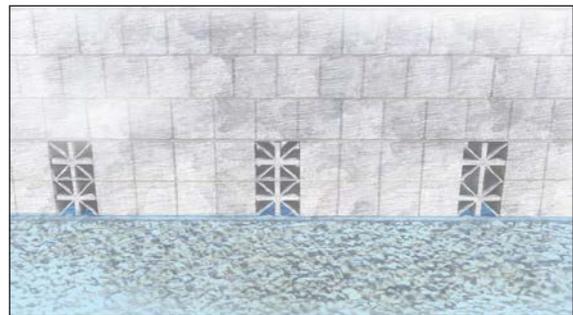
- Helps to relieve the stress and pressure of holding back storm water
- Can be equipped with trash rack/angled fence to allow water through without debris clogging

### Considerations:

- Be sure to check with your municipality or county requirements before constructing
- Openings can clog quickly if undersized or blocked by debris
- Walls and fences can drastically alter the flow of runoff in an area
- Provide a second block opening to account for normal sediment buildup along the wall.



Trash rack attached to fence.



An example of larger and more frequent wall openings in a block fence.

## G. Driveways

- Driveways must not block or divert storm water flow.
- Driveways should not be put across roadside ditches without dipping them or installing a properly-sized culvert.

## H. Erosion Protection

If the foundation of your house or property is next to a wash or river channel, you may want to install erosion protection to prevent the bank of the wash from eroding and potentially causing damage. Depending on the severity of the erosion, you should consider hiring an engineer (See the “Hiring an Engineer” section) to develop a solution for the erosion problem. Check with the local municipality or the county to determine the need for permits.



It's important to install rip-rap on both sides of the channel to prevent erosion

### **Do I need to over-excavate when installing gravel/river rock material in any wash, channel or roadside ditch?**

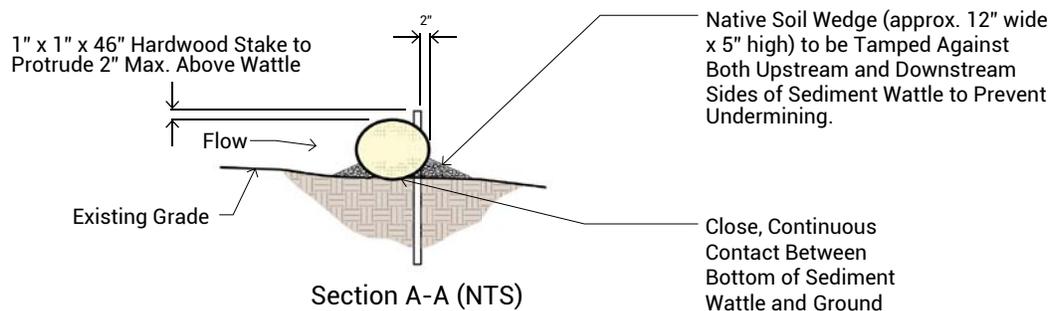
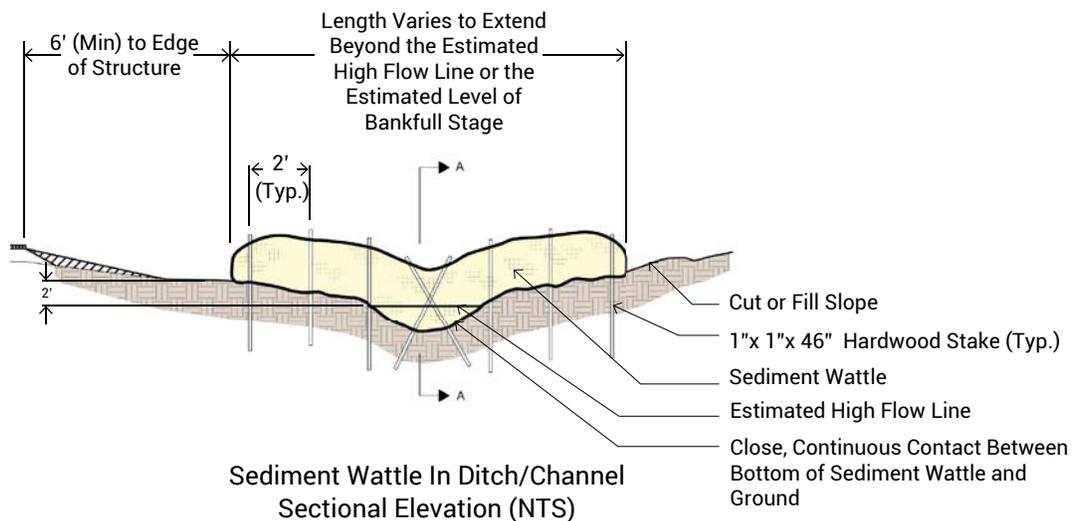
Yes, make sure that river rock or any channel lining is “inlaid.” When installing gravel or river rock lining material, you must first excavate to the depth of the material you are installing and then inlay the material.

Do not place material on top of the swale bottom, wash bed, retention basin or channel bottom. Don't dump or place fill material, landscaping gravel, or rip-rap material on top of the ground, bottom or sides of the drainage facility without first excavating.

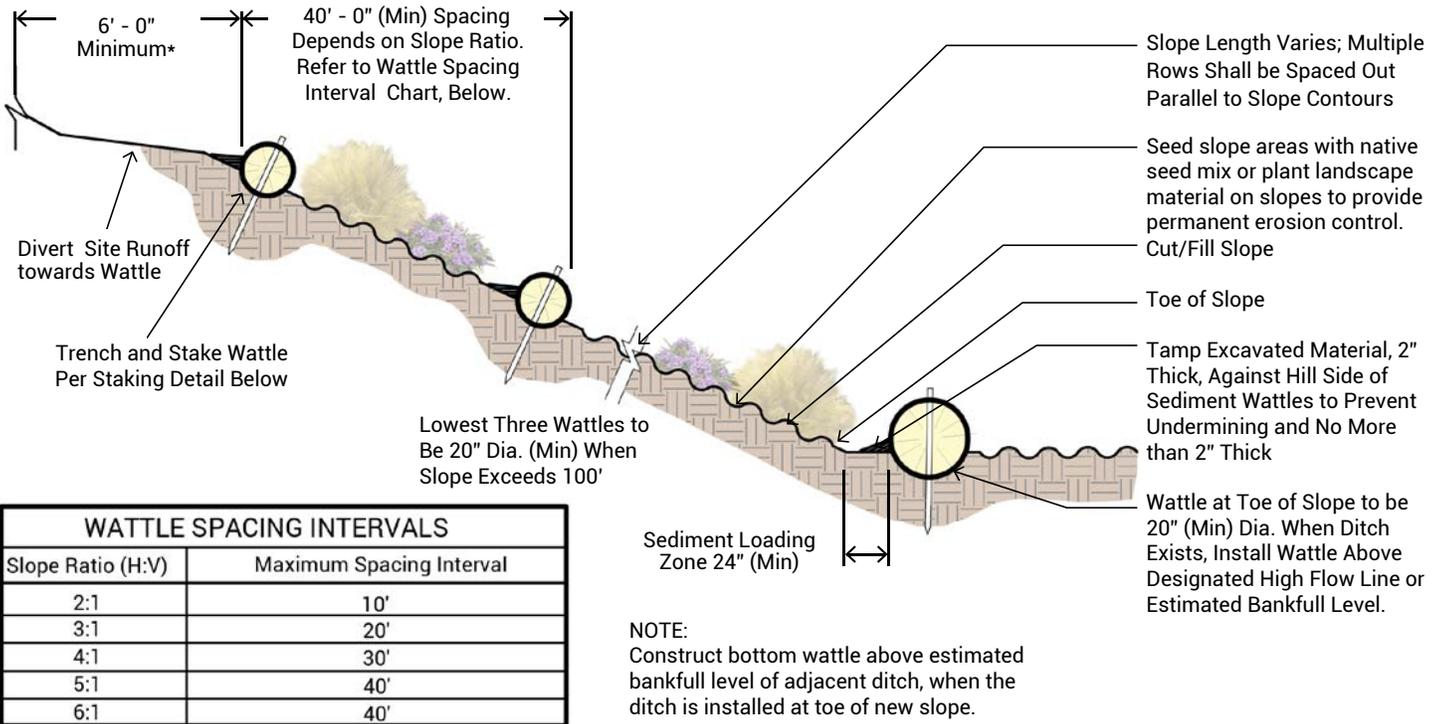
If you don't over-excavate before placing landscaping or lining material in a drainage facility, water may not be able to enter the channel. At a minimum, the capacity of the channel or basin will be reduced. This can cause the drainage facility to overflow and divert or back water upstream.

**Temporary Sediment/ Erosion Control-** is part of an overall stormwater management approach aimed at reducing or eliminating the negative impacts of stormwater runoff. Today, stormwater management includes control of flood flows, reducing erosion, and improving water quality. This can be accomplished by implementing what are known as Best Management Practices (BMPs). BMPs are structural, vegetative (seeding or planting) or other managerial practices used to treat, prevent or reduce water pollution. BMPs, such as the GI/ LID techniques presented within this guide, are considered permanent - while other BMPs are considered temporary - but both are part of much larger BMP approaches to stormwater management. There are a number of BMP approaches that often include native hydroseeding as a component to sediment and erosion control efforts. The temporary sediment wattles described below are an excellent example where native hydroseeding working in conjunction with these BMP practices can assist in permanently rehabilitating disturbed soils. The implementation of these temporary BMP sediment wattles with native seeding can have multiple benefits that include:

- Preventing erosion.
- Slowing water so it soaks into the ground.
- Preventing sediment from clogging drainage structures.



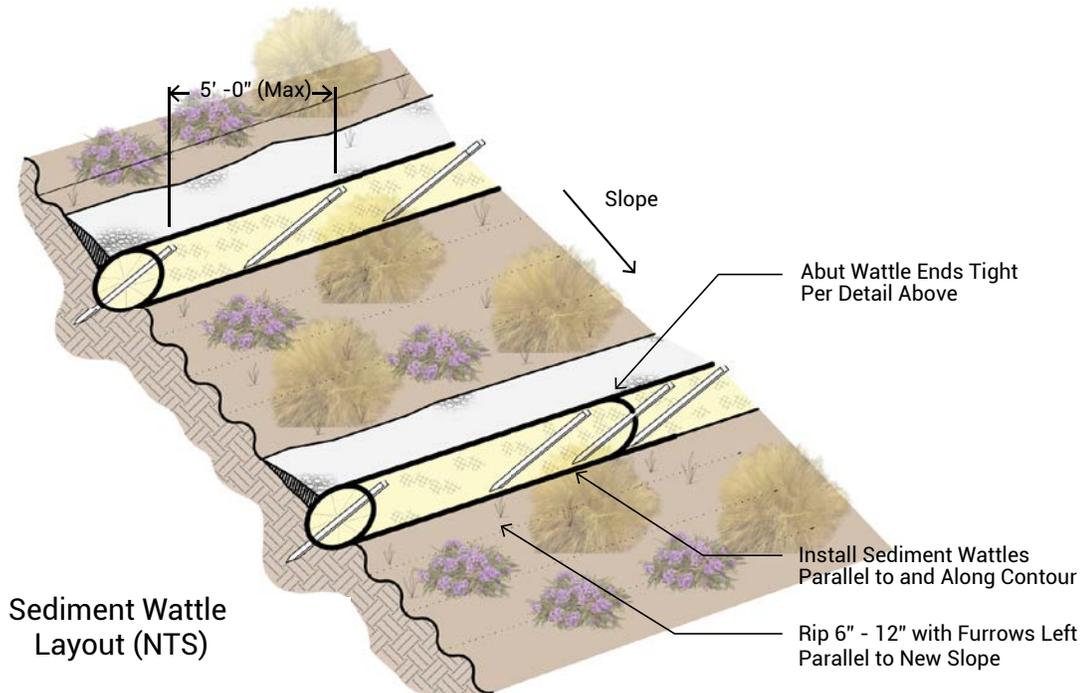
**Fiber Log (Wattles) Check Dam Construction Detail**



**Section (NTS)**

**\* Notes:**

- 1) Top Row Shall Not be Placed within 6' - 0" of Edge of Structure
- 2) For erosive soils, place rows of wattles closer together.
- 3) For soils with low erosive potential, place rows of wattles further apart.



**Sediment Wattle Layout (NTS)**

**Fiber Log (Wattles) Check Dam Construction Detail**

## I. Barns, Corrals, and Horse Stalls

Barns, corrals, and horse stalls often take up large areas. These structures can worsen drainage issues if placed without careful consideration on how they will affect the way storm water flows across your property. What was once a minor nuisance of floodwaters can suddenly become a much larger flooding issue.

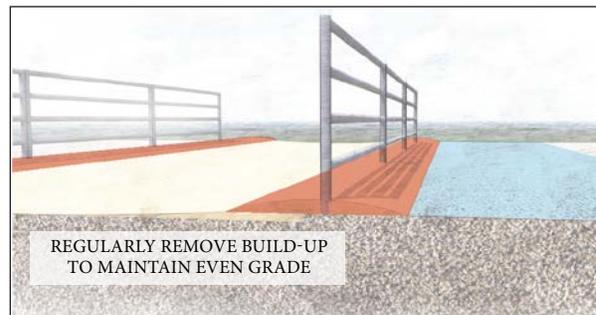
### Impacts of Elevated Barn and Stall Floors

Horse stalls and barns with a finished floor that is elevated above the ground level become barriers to drainage flow. What was once gentle sheet flow across an open property can become a much stronger channelized flow as it is forced to go around the elevated pad. Be mindful of where you place these and where the flow of storm water is being redirected.

### Impacts of Corrals

Corrals pose another significant drainage issue since they take up a larger area. On average a 1,000lb horse produces about 50lbs of raw waste per day. This combined with regular foot traffic builds up a berm of material along the edges of enclosures.

This barrier along the perimeter of the corral redirects runoff to other areas, which can lead to stronger and more destructive flows downstream. It is recommended that you regularly remove the build-up to maintain an even grade so storm water can pass through unimpeded. A temporary method to help alleviate flooding would be to carefully locate breaches in the built-up berms that still allow water to pass through. For raised stalls and corrals, special consideration should be made to how water moves around these structures.



## **J. On-Lot Retention**

### **Why does my yard have a depression or a berm around it?**

Some large properties and structures have on-lot retention through berms or grading of the lot that was required as part of their original building permit. The purpose of this is to collect and retain runoff from the roof, driveways and the lot itself as required by the local ordinance. This was a common practice in older subdivisions, and today on some large individual lots. The CC&Rs for your subdivision or recorded plat should contain information on any on-lot retention requirements.

### **Do I have to keep the depression in my yard or can I fill it in?**

In the process of landscaping or re-landscaping your yard, the storage capacity of any depressed areas designed to retain storm water runoff must be maintained. If filled in, runoff from your lot may end up in your house or pool, your neighbor's yard, or overload downstream drainage facilities. Take a look at Low Impact Development (LID) and floodproofing techniques for additional ways to improve your yard's aesthetics and storm water retention. This guide gives a brief overview of some techniques but for more information you can refer to additional sources listed at the end of this guide.

## 2.3 Storm Water Management/ LID Techniques

This guide will introduce many different strategies you can implement to better manage storm water flow across your property which, in turn will help protect yourself and your property from storm water runoff and flooding. Each technique is introduced briefly here but for more information refer to the *Homeowner's Guide to a Stormwater Management Planning*. It is important to note that some of these techniques may require you to obtain permits before constructing.

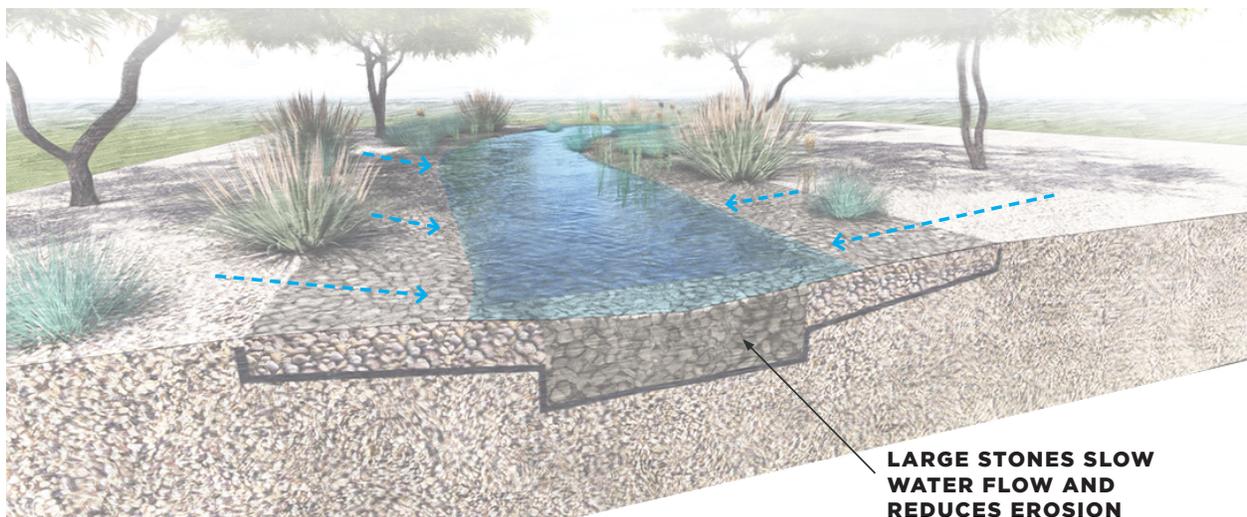
**Swales** - Swales are open, shallow channels that direct runoff to a collection point. These can be rock lined or have planting.

### **Benefits:**

- Reduces runoff volume and speed.
- Swales with planting along the sides help capture and remove pollutants.
- These can direct the water flow to a landscape area for irrigation.

### **Considerations:**

- Adding a bottom layer of larger stones reduces the water speed.
- Gravel or river rock will protect swale from eroding.



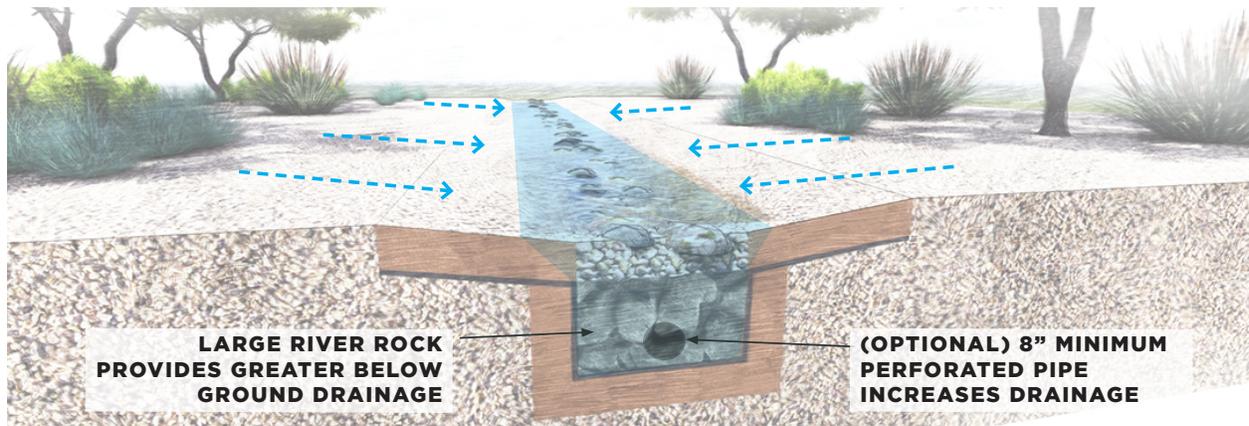
**Infiltration Trench** - An open trench filled with gravel that collects runoff and directs water similar to a swale and promotes infiltration into ground

**Benefits:**

- Reduces runoff volume and speed
- Can direct water flow to landscape
- Captures sediment
- Can fit a narrower area than a swale

**Considerations:**

- Higher cost than a swale
- Can look like a dry stream bed
- Caliche or compacted soils may need to be broken up underneath
- Including a perforated pipe in the trench increases drainage



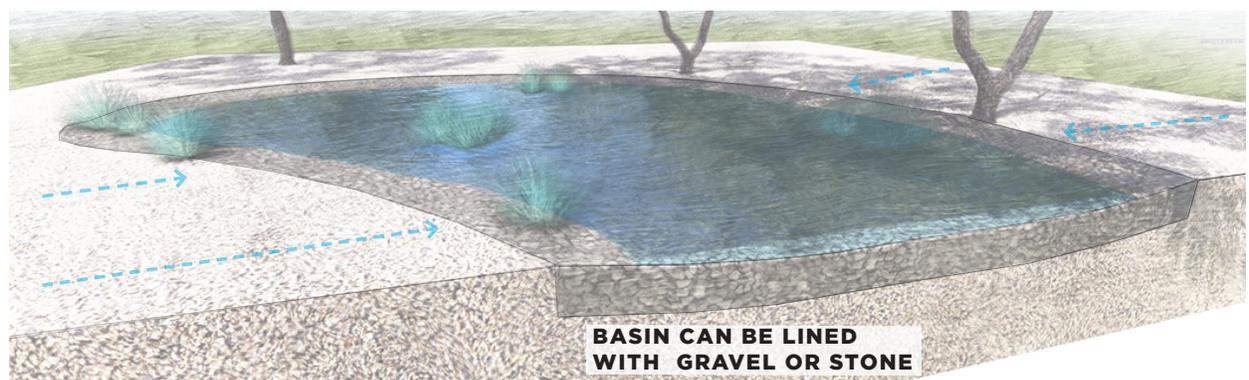
**Basins** - depressions in the landscape that can retain storm runoff.

**Benefits:**

- Collects and holds runoff
- Traps sediment
- Low maintenance
- The water can supplement irrigation needs and can support more lush plantings (see Rain Garden)

**Considerations:**

- Keep in mind where runoff will flow if it overflows.
- Not recommended for slow draining soils, caliche, or soil contamination
- Water should not stand for more than 36 hours to prevent mosquitoes



**Rain Garden** - Rain gardens are sunken garden areas where the existing soil has been replaced or mixed with mulch or rocks. It is then planted with deep-rooted plants that capture, absorb, and help infiltrate storm water.

**Benefits:**

- Collect and holds runoff
- Filters pollutants
- Low maintenance
- Collected water supports more vegetation

**Considerations:**

- The first few years require higher maintenance while plants become established
- In later years, plants may require thinning



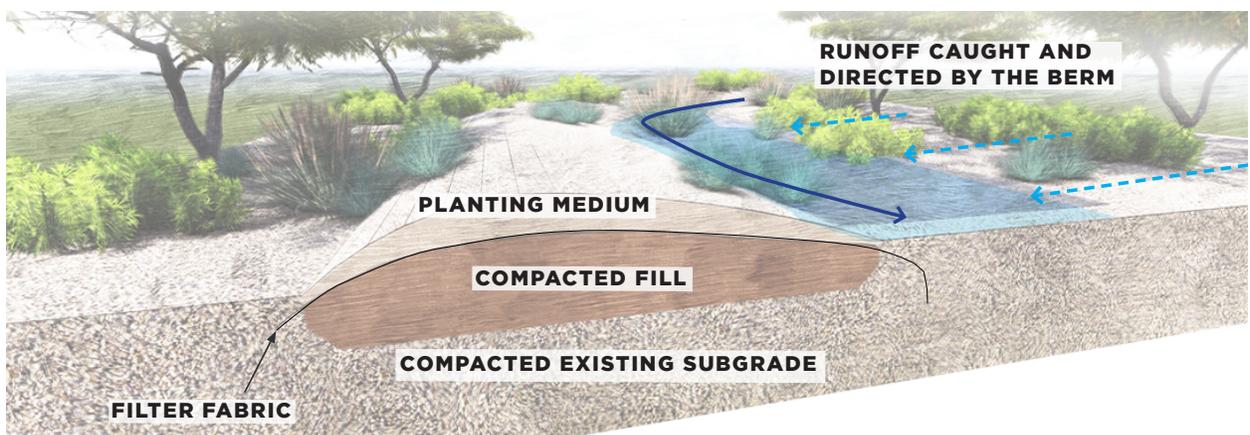
**Berms** - Berms are mounds of earth with sloping sides that direct runoff.

**Benefits:**

- Directs water flow to basins or other landscape areas
- Upper layer of soil can be planted
- Adds interest to a flat landscape

**Considerations:**

- Can be strengthened by inlaying aggregate along the banks and adding a layer of filter fabric.



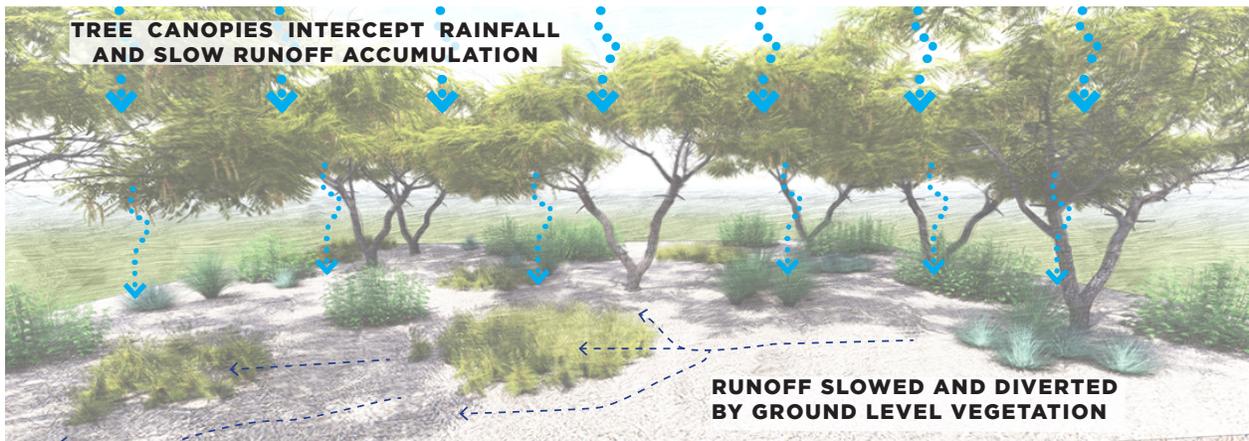
**Vegetative Cover** - Planting such as trees, shrubs, and groundcover help stabilize the soil as well as slow and filter runoff.

**Benefits:**

- Reduces erosion and traps sediment
- Increases cooling and shade
- Provides habitat for wildlife

**Considerations:**

- The first few years require weeding and watering while plants establish
- In later years plants may need to be thinned
- Regularly remove debris and sediment build up after flood events



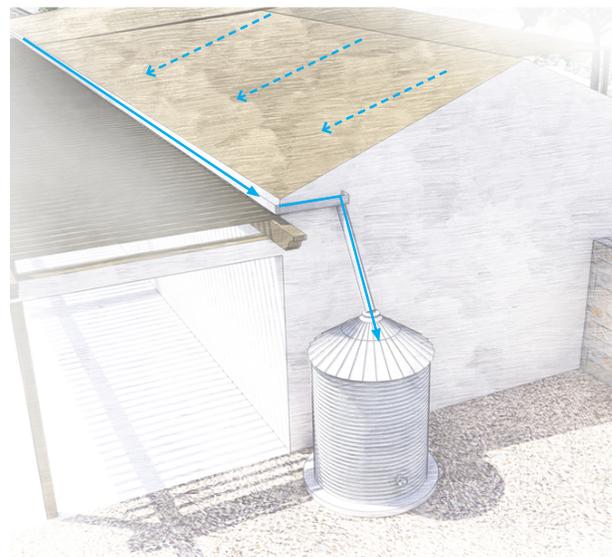
**Downspouts and Roof Runoff** - Existing gutters or installing roof gutters can prevent water build up around the home.

**Benefits:**

- Runoff can be directed towards rain gardens, basins, or other landscape
- Install a cistern to collect roof runoff for later non-potable use like irrigating or washing your car
- Easy and cost effective to retrofit
- Indoor water use with proper filtration

**Considerations:**

- Check rain gutters, cisterns, debris filters, and other connections regularly to prevent debris buildup
- Ensure first flush devices are emptied and functioning properly
- Verify sealants and piping materials are non-toxic



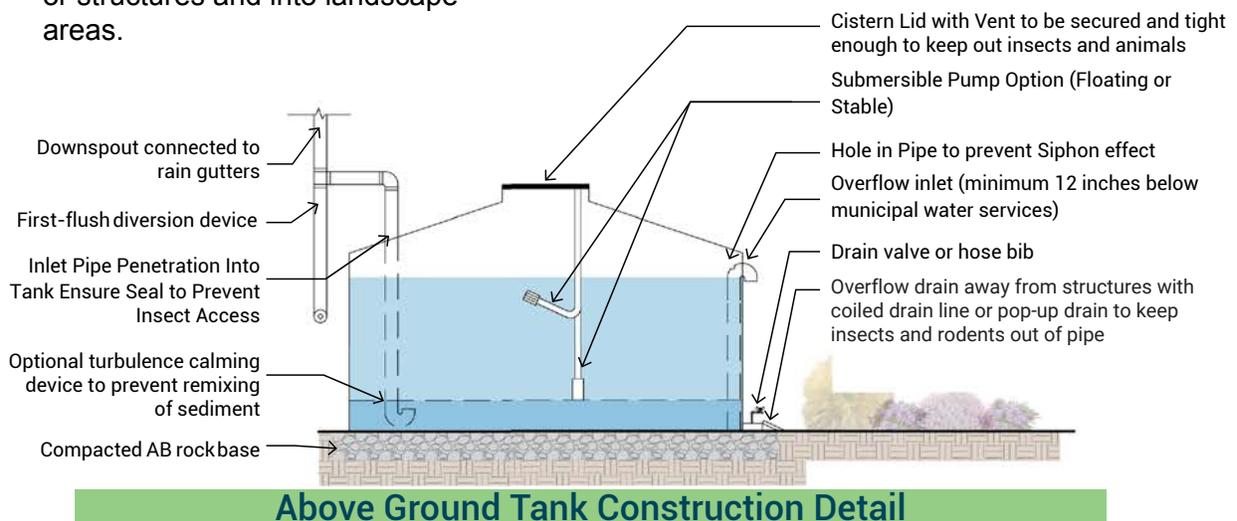
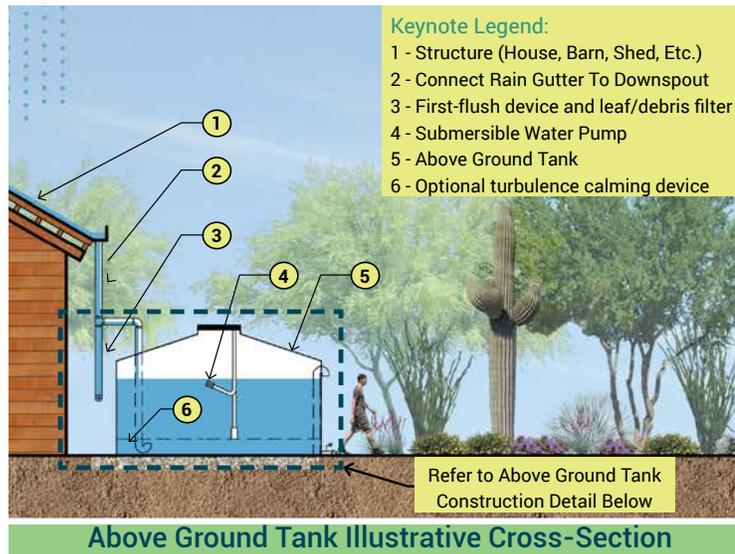
**Above Ground Rain Tank** - also called a Rainwater Cistern, is a reservoir tank system used for storing rainwater. Rainwater runoff from roofs and other structures can be directed to these tanks from a gutter/ collection system for storage and later use. Tank designs can range from a simple rain barrel at the bottom of an existing downspout to a more extensive higher volume system that can provide a substantial amount of rainwater storage for landscape watering and other outdoor non-potable water uses. Collected rainwater can be used for potable water with filtration. The distribution and reuse of rainwater from an above ground cistern is typically provided through a gravity-fed system of a garden hose connected to the water spigot. If desired, a small electric or solar powered irrigation controller and associated irrigation valve and distribution piping can be added to automate the system. Tanks should be located at the highest place in the landscape while ensuring the tank inlet is still below the debris filter to ensure positive drainage and allow for gravity feed systems irrigation systems and timers. Drip systems and irrigation mechanisms work well with gravity systems. Other considerations for location are where the water is needed and maintaining views.

**Benefits:**

- Collect and holds runoff
- Can offset water costs when used to supplement irrigation
- Depending on size and location, can be easy and cost effective to install

**Considerations:**

- Rain water can pick up pollutants from bird waste or other chemicals from your roof so it isn't recommended to use the collected water for edible planting
- Direct overflow away from house or structures and into landscape areas.



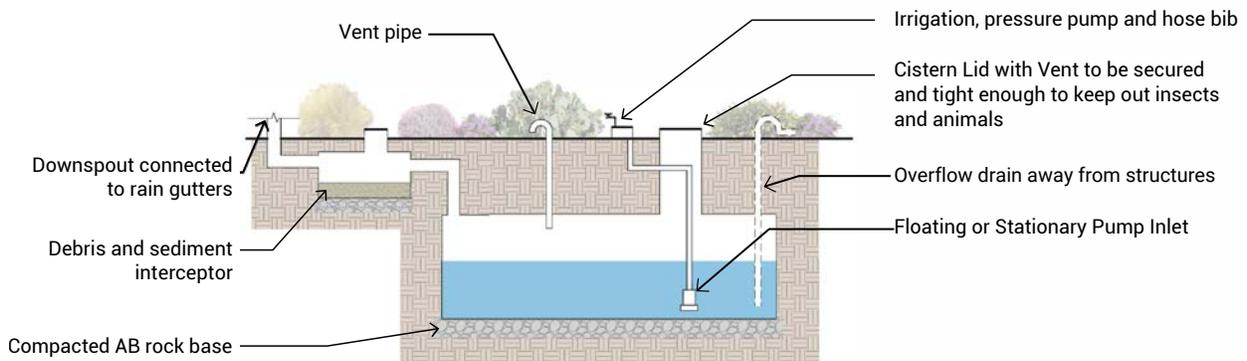
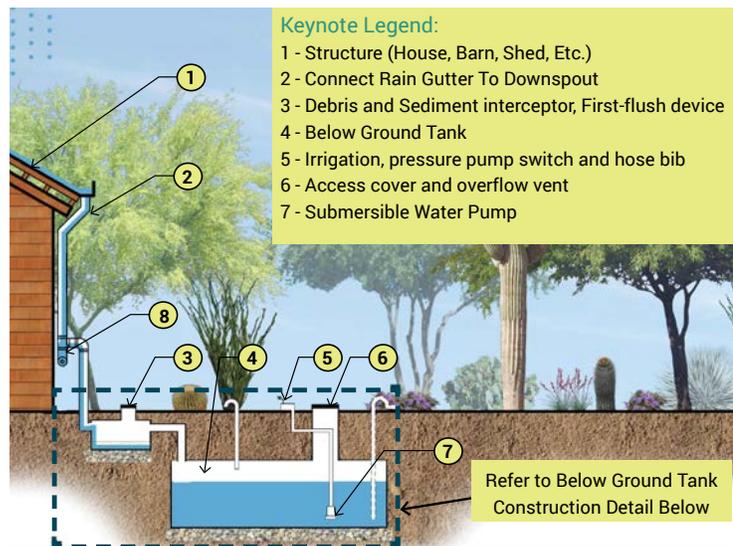
**Below Ground Rain Tank** - also called a Rainwater Cistern, is an in-ground reservoir tank system used for storing rainwater. Rainwater runoff from roofs and other structures can be directed to these tanks from a gutter/collection system for storage and later use. Tanks located below grade can provide a substantial amount of water storage for non-potable use and being below grade removes the tank from any visual intrusion into the landscape around a residence. Each rain tank system is unique in size, shape, material, and weight and should be evaluated on a case-by-case basis, as these choices will have a direct effect on location, installation, maintenance, and costs. Proper material selection, based on use below grade and the sizing of the system, is important when selecting and designing your rain tank system. You will need to know that the system selected has the structural integrity for use below grade and that the system has been sized to collect and store the water you reasonably expect to use. Determining the rain tank materials and right sizing the system will affect installation, operation, and on-going maintenance costs.

**Benefits:**

- Collect and holds runoff
- Can offset water costs when used to supplement irrigation

**Considerations:**

- Rain water can pick up pollutants from bird waste or other chemicals from your roof so it isn't recommended to use the collected water for edible planting
- Direct overflow away from house or structures and into landscape areas.



**Below Ground Tank Construction Detail**

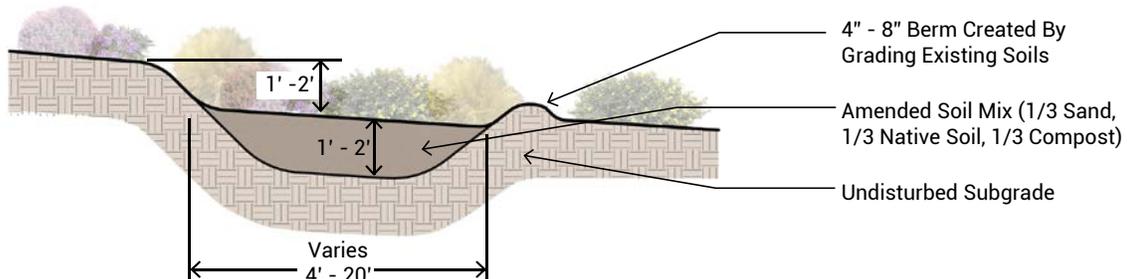
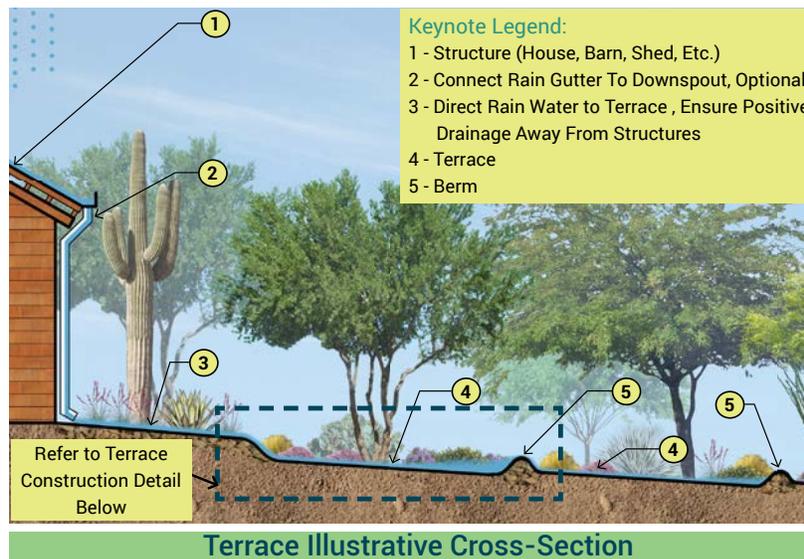
**Terrace** - is an earthen embankment, or a combination ridge and channel, constructed across the site's natural slope that collects stormwater and slows the flow. Terracing is also an effective soil conservation practice that helps to prevent rainfall runoff on sloping land from increasing in velocity, resulting in severe erosion and loss of valuable topsoil.

**Benefits:**

- Slows the velocity of stormwater flow across an area
- Holds pockets of water that have more time to infiltrate into the soil
- Collected water can support more vegetation

**Considerations:**

- Using an amended soil mix will improve the water holding capacity of the soil.
- You can incorporate larger materials like rocks, logs, or brush on the sloped area to assist with slowing the flow of the rainwater.



**Terrace Construction Detail**

**Check Dam** - are generally used in concentrated rainwater flow areas such as bio-swales, minor washes, and ditches on your property. Check dams are placed perpendicular to the direction of flows or across ditches to reduce stormwater flow velocities, prevent channel erosion, and to filter out sediment. Check dams can be both permanent and temporary barriers, constructed from a variety of materials including rock, sand bags, and other materials found on site (logs, native materials, etc.).

**Benefits:**

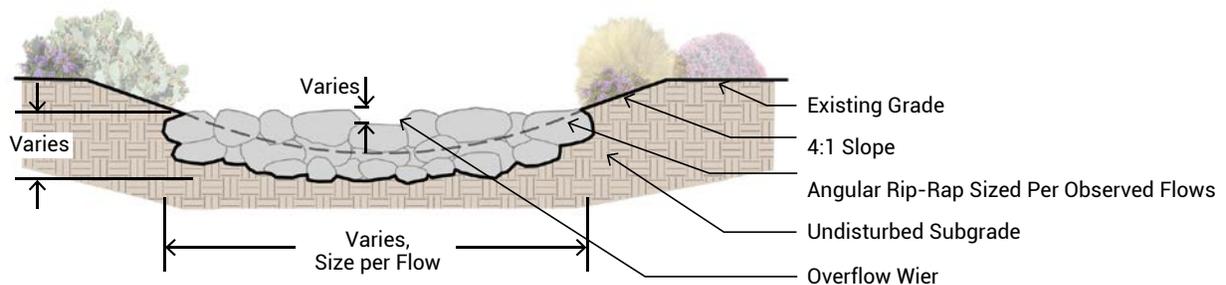
- Slows the velocity of stormwater flow across an area
- Holds pockets of water that have more time to infiltrate into the soil

**Considerations:**

- The use of a check dam is only meant to slow the water, and check dams should not be placed where it will change the flow patterns of the wash or affect any downstream neighbors
- Ensure appropriately sized rocks are selected for the largest flows expected. Place rocks to effectively interlock rock edges to resist flows.



Check Dam Illustrative Cross-Section



Rock Check Dam Construction Detail

**Labyrinth Infiltrator** - which is the same as the basic trench, but is in a “zig-zag tooth” form folding the trench line into a smaller area to gain more infiltration.

**Benefits:**

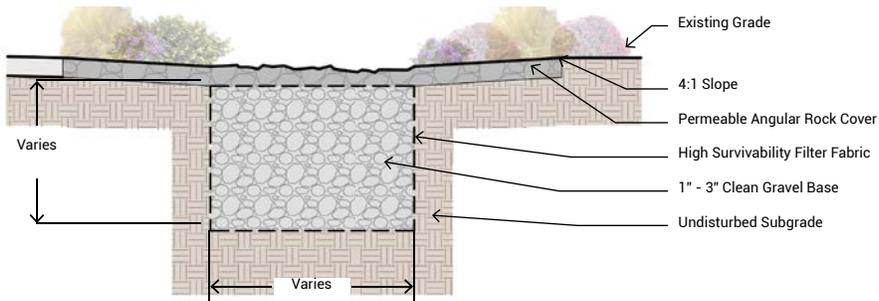
- Reduces runoff volume and speed
- Can direct water flow to landscape
- Can fit a narrower area than a swale

**Considerations:**

- Higher cost to than a swale
- Can look like a dry stream bed
- Caliche or compacted soils may need to be broken up underneath
- Must include sediment trap upstream to ensure infiltration function.



Plan View Example of Labyrinth Infiltrator



Infiltration Trench Construction Detail

**Spiral Infiltrator**- similar to both a Zuni Bowl and a Bio-Swale, but the spiral shape is a way to redirect and slow water runoff to reduce erosion and allow water to slowly percolate.

**Benefits:**

- Reduces runoff volume and speed
- Can direct water flow to landscape
- Can fit a narrower area than a swale

**Considerations:**

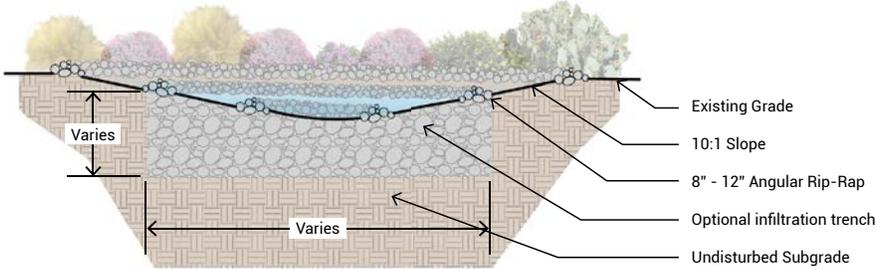
- Can look like a dry stream bed
- Caliche or compacted soils may need to be broken up underneath
- Must include sediment trap upstream to ensure infiltration function



Plan View Example of Spiral Infiltrator



Spiral Infiltrator Illustrative Perspective



Spiral Infiltrator Construction Detail

**Zuni Bowl**- a type of rainwater runoff management technique that can be utilized to address minor washes, bio-swales, and concentrated flow areas that are experiencing head cutting (a sharply eroded vertical drop) and erosion. Zuni Bowls are excavations that are layered with large stones that are securely placed to create steps for energy dissipation, and a bottom plunge pool for rainwater capture and diversion.

**Benefits:**

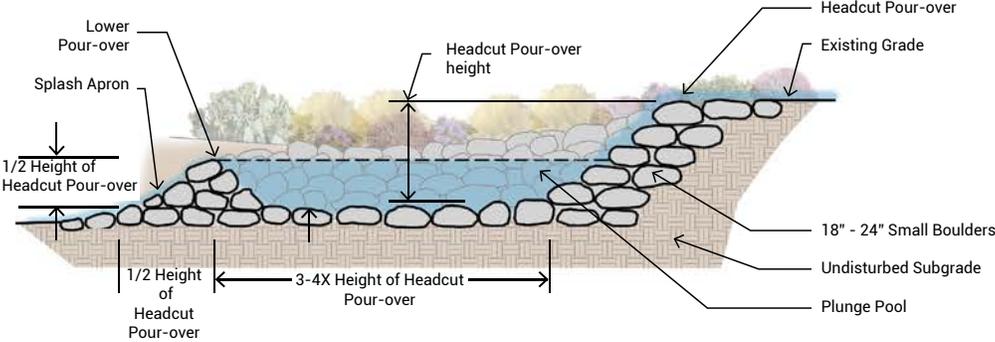
- Reduces runoff volume and speed
- Can direct water flow to landscape
- Captures sediment
- Can fit a narrower area

**Considerations:**

- Can look like a dry stream bed
- Caliche or compacted soils may need to be broken up underneath



Zuni Bowl Illustrative Perspective



Zuni Bowl Construction Detail

## 2.4 Floodproofing Measures

Flood proofing measures are any combination of structural and non-structural modifications that help reduce the risk of flood damage. Measures that can be applied to structures such as your home, sheds, and barns are divided into two categories, wet floodproofing and dry floodproofing. To find more information on floodproofing measures see additional materials such as FEMA's Homeowner's Guide to Retrofitting. Also check on the website of your local municipality and Flood Control District for recommendations and requirements. It is important to make sure that your mitigation methods comply with all applicable floodplain regulations.

### A. Dry Flood Proofing Measures

**Waterproofing Structures (Dry Floodproofing):** - A dry floodproofed structure has been made watertight along the level where floodwaters could enter the structure. Applying waterproof membranes or other sealants to the exterior of structures and watertight shields for doors/ windows are an effective protection during a flood.

#### **Benefits:**

- Watertight barriers can be easy to retrofit into existing structures
- Effective at protecting the interior of a structure from smaller flood events.

#### **Considerations:**

- Simple methods include blocking off or sealing the base of doorways and low windows
- Can be difficult to analyze and choose the best methods for waterproofing. It is recommended that you consult with a design professional such as a landscape architect.



Door barriers can be a quick and cost effective method to dry flood proof your property.

## B. Wet Flood Proofing Measures

Some structures can be made from flood resistant materials and allows water to flow through during a flood event with minimal damage to the structure. Barns or stables may be better suited for this as the lower portion of these structures are usually open. For more information refer to FEMA's documents on wet floodproofing here <https://www.fema.gov/wet-floodproofing>

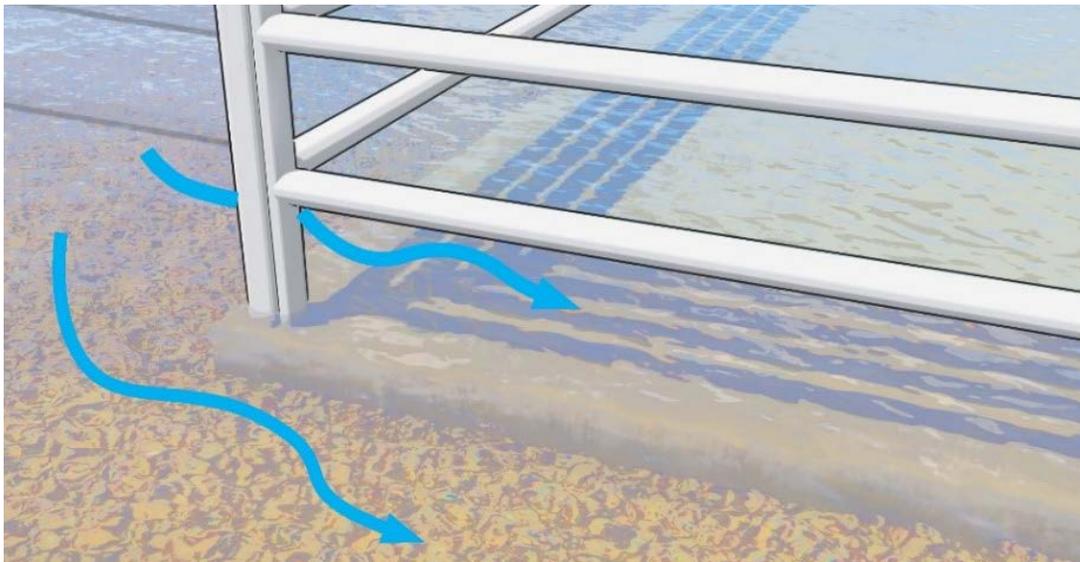
**Wet Flood Proofing:** - Some structures can be made from flood resistant materials and allow water to flow through during a large flood event. Barns or stables may be better suited for this as the lower portion of these structures are usually open.

### **Benefits:**

- Flood resistant materials sustain less damage when floodwaters pass through
- Can be more cost effective than elevating some structures

### **Considerations:**

- Floodwaters often leave sediment or debris after a storm event that will require clean up
- Ensure there are openings and a flow path for water to exit the structure



Corrals and Barns with open lower segments are good example of structures that can allow flood waters to safely pass through.

## C. Emergency Flood Proofing Measures

In the event of flooding in areas where you have not had it before or need a quick way to divert flows away from valuable areas such as your home, there are emergency floodproofing techniques that can be deployed quickly to help prevent flooding. These techniques can be initiated on relatively short notice of potential flooding using stored or natural materials.

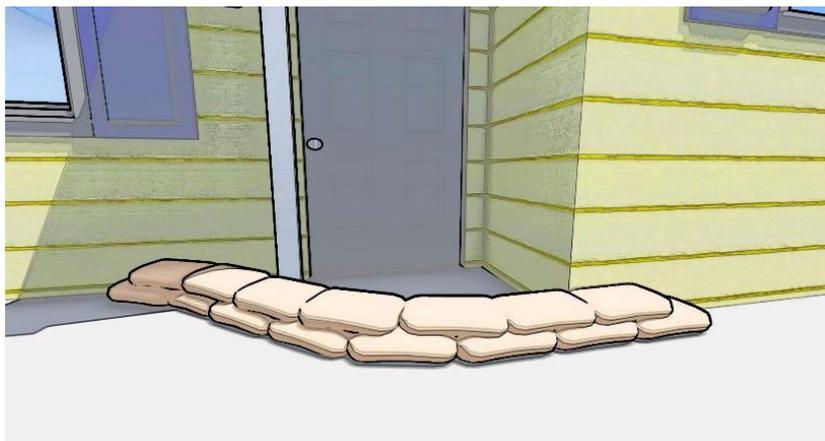
**Sandbag Walls:** - Sandbags can be stacked to form a quick barrier to divert, prevent, or reduce floodwaters and are most effective when used to protect key areas such as doors and garages. Creating a barrier around your entire home may cause flooding by trapping stormwater between your home and the barrier. Municipalities often offer sandbags in preparation for monsoon season. Check their website to find out more information like where is the nearest sandbag pick up location.

### **Benefits:**

- Quick to construct
- Effective in protecting vulnerable areas such as doors and low windows

### **Considerations:**

- Most effective when used together with protective plastic to reduce water seepage
- When filling, do not completely fill the bags with sand. Half-filled bags can be packed together.
- If constructing near your home, ensure that runoff from downspouts or from the roof is not trapped inside the sandbag wall and against your home. This can cause flooding.
- Consider purchasing a water pump that can handle a couple of gallons per minute to pump seepage from behind the wall.

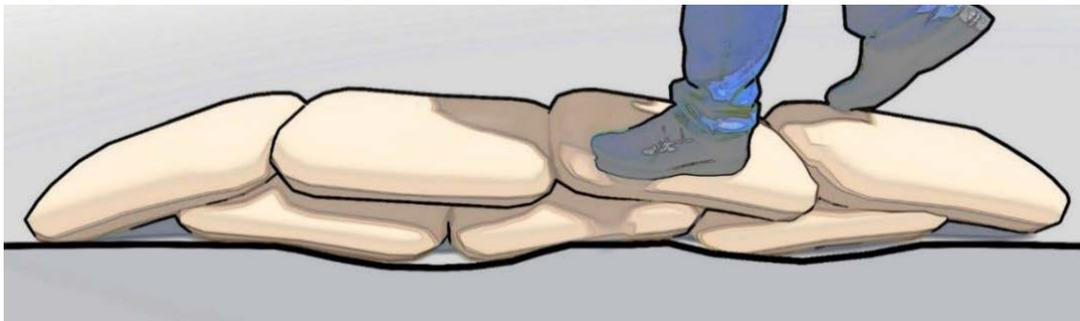


Sandbag barriers are effective when used to divert water away from vulnerable areas.

## Setting Up a Sandbag Barrier

Filling sandbags and setting up barriers are physically demanding activities so it is important to employ them strategically to divert water away from key areas such as doors and garages. Creating a barrier around your entire home is time consuming and may cause flooding by trapping stormwater between your home and the barrier. Here are some steps to help maximize the effectiveness of your sandbag barrier.

1. Remove debris from the area the bags will be placed.
2. Place bags parallel to the flow of water.
3. Fill the low spots with sandbags first and then build up the rows.
4. Place each bag tightly so it overlaps the previous bag's edge.
5. Offset each row of sandbags by one half of a bag length. Offsetting the seams makes for a stronger seal.



After placing each row, walk on the bags to flatten them and reduce seepage.

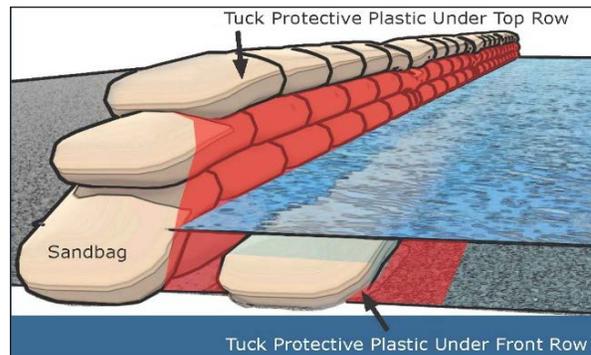
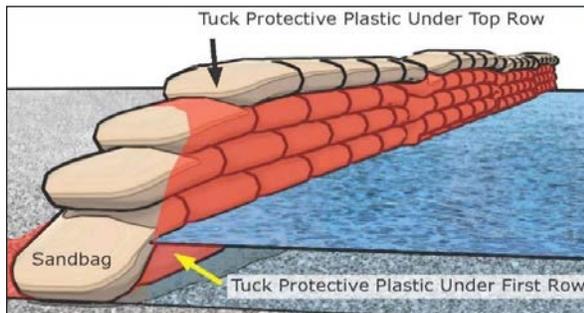
## Sandbag Disposal

Clean, filled sandbags can be saved and reused at other flood sites for up to six months. Unused, empty sandbags can be stored for future use or recycled but sandbags that have come in contact with floodwaters naturally trap contaminants and should be disposed of properly to prevent becoming a health hazard. Always wear protective clothing such as gloves and boots to keep yourself safe when handling soiled sandbags. Remember that the sand from used sandbags should never be used in sandboxes, playgrounds, or other areas where it may come in direct contact with people.

Contact your local landfill or other disposal site for detailed instructions on where to get rid of your used sandbags. Especially after a large flood event, some areas may have special rules or collection dates for sandbags and flood-damaged materials. Check with your local municipality for additional instructions or announcements. Do not dispose of sandbag material in your local storm drain as this will clog them and can potentially cause more flooding issues.

## Wrapping Sandbag Barriers in Plastic

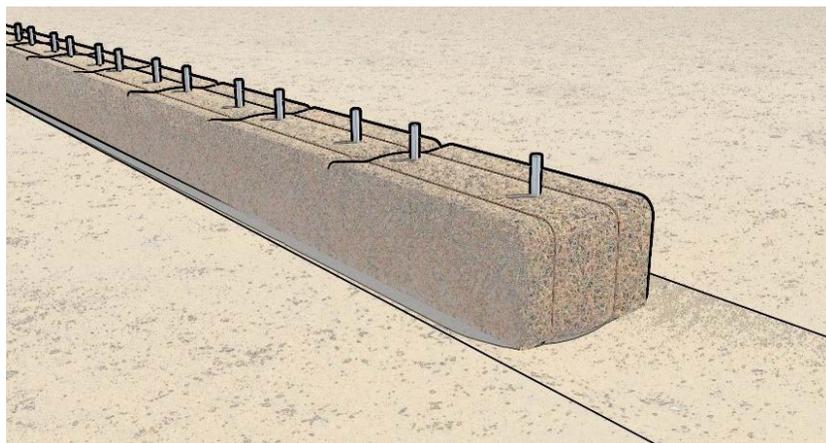
Water can start to seep through your barriers but you can make it more watertight by wrapping them in protective plastic. The plastic sheet will help repel floodwater as long as the sheets are held down and secured by sandbags. Two easy methods of securing sheets are shown in the diagrams below. Also, consider having a water pump that can handle a couple of gallons per minute to pump any seepage that has crept behind your barrier.



## Hay Bale Barriers

A barrier made from hay bales staked into the ground can be a quick short-term line of defense during a flood event. They are also helpful in trapping the sediment floodwaters pick up. Hay bales should be firmly staked in place in a four to six-inch-deep trench and backfilled with the excavated dirt.

Be sure to dispose of these in a timely manner as the exposure to the stormwater and anything it may have been carrying can rapidly break down the bales.

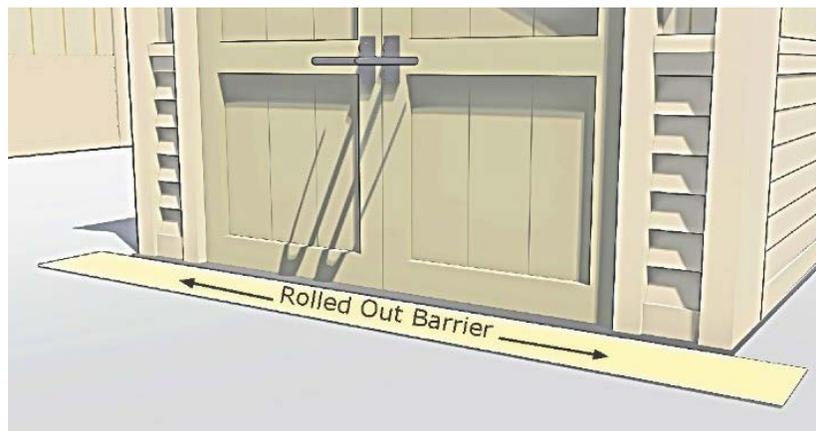


A hay bale barrier secured with stakes in a shallow trench.

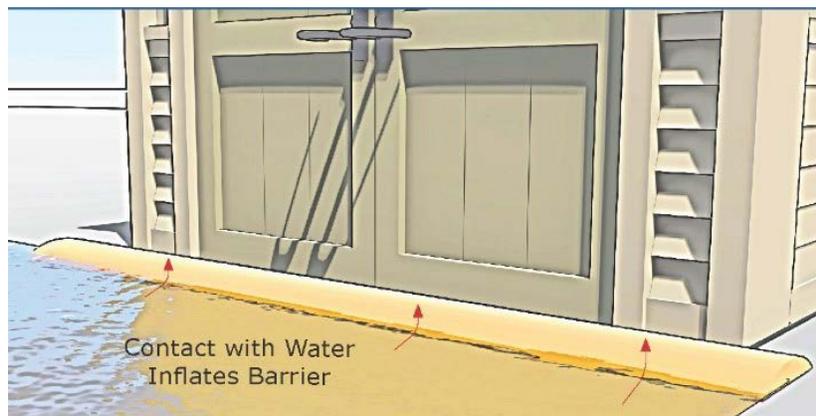
## Self-Activating Flood Barriers

Self-activating flood barriers, also called sand-less sandbags, can be found at your local hardware stores or at online retailers. These barriers contain material that expands when it comes into contact with water forming barriers similar to sandbags. Many self-activating barriers can be reused throughout the year. These are most effective when placed in areas such as doors and along driveways and can be stacked to create multiple layers if needed. Residents can roll out these barriers before leaving for work if there is forecast of heavy rain or flooding.

These reusable barriers lay flat again after the moisture evaporates out and can be stored throughout the year. While dry, the barriers are lighter and easier to carry than conventional sandbags. They can also be stacked in multiple layers for increased protection. These types of barriers may be an easier and more convenient option for those who don't wish to manually fill, transport, and dispose of traditional sandbags.



Before: The barrier is rolled out in front of the area you want to divert water away from.



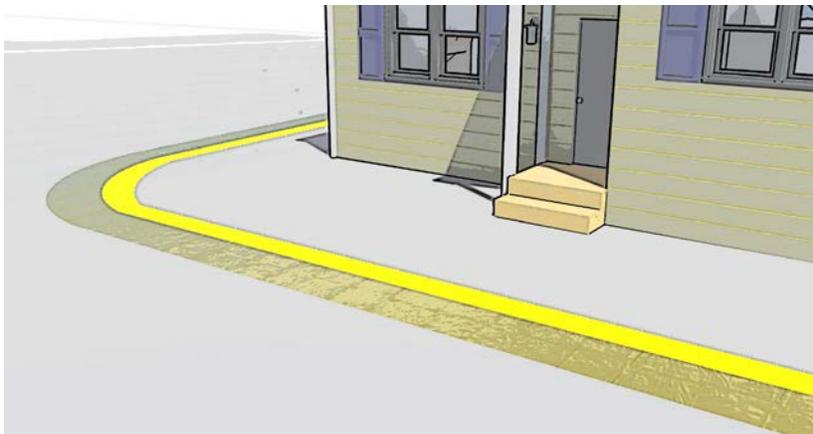
After: When water comes in contact with the barrier it inflates diverting further water from the area.

## Water Gates

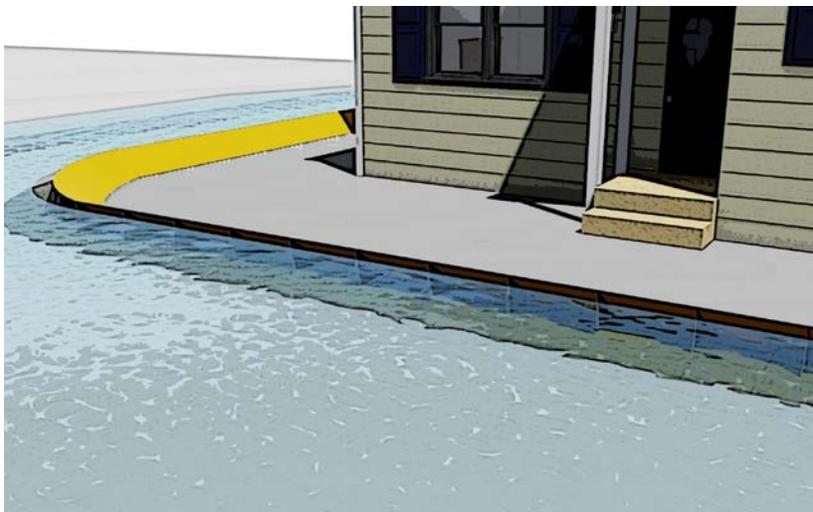
Water gates are another kind of water barrier that self-rises when the flow of water pushes against it. The barrier is rolled out and oriented to face into the flow of runoff. The flexible nature of the heavy-duty plastic allows it to bend and form curves if needed.

Flood waters flow into the barrier deploying it automatically. The barrier uses the weight of the water to hold down and stabilize it, giving the strength needed to stop the flow.

Water gate barriers come in many different sizes and lengths and can be linked together to create longer sections. These barriers can be set up or removed in minutes and easily packed for reuse.



Before: The barrier is rolled out in front of the area you want to divert water away from.



After: The rising water level opens that barrier, diverting further water from the area.

## 2.5 Other Tips

Depending on the scale and complexity of the floodproofing techniques, property owners may want to consider hiring an engineer to determine the best and most cost-effective solutions for their specific situation. Also, many of these techniques require a permit from Maricopa County or the local municipality.

### A. Hiring An Engineer to Evaluate Drainage or Flooding Issues

If the drainage problems you are experiencing are complex or the measures for effective mitigation of flooding hazards on your property are beyond the recommendations contained in this resource guide, you may want to consider hiring an engineer to assist with resolving those issues. Here are some helpful tips to hire an engineer:

- If you choose to start your engineer search online, some useful keywords are ‘drainage,’ ‘hydrology,’ ‘hydraulics,’ ‘erosion,’ ‘water resources,’ ‘floodplain,’ and ‘flood control.’
- Check the Arizona State Board of Technical Registration website to confirm that the engineer you are considering hiring is an active registered Professional Engineer (PE). You can also check for complaints or disciplinary actions against an individual through the Board’s website at <https://btr.az.gov/>.
- After identifying an engineer, a good first step is to arrange for an on-site visit so the engineer can see the problem area in person and hear firsthand about the flooding and/or drainage problems you are experiencing. You can expect to pay the engineer an initial retainer fee for this site visit based on their hourly billing rate.
- If the engineer indicates they can assist you in resolving your problem based on the outcome of the site visit, ask for a written proposal that includes the scope of services to be provided, clearly defines the work product to be delivered, outlines a work schedule, and provides a fee estimate for the services to be rendered.
- To the extent possible, confirm that the engineer you intend to hire is well-versed in FEMA floodplain regulations, environmental permitting policies, and current drainage ordinances of the governmental jurisdiction where your property is located.
- Ask the engineer about other similar projects they have recently completed. Follow up with any references provided.
- Consider soliciting proposals from two or three engineers for comparison of their qualifications and the recommended approach to resolving your drainage-related problems. It’s not always best to select an engineer solely on the basis of cost. Be sure you are satisfied with the answers to all of your questions before you decide to sign an engineering services contract.

## 2.6 Flood Safety - Protecting Yourself and Your Property

Here are some steps you can take to prepare for a flood and protect yourself and family members.

### A. Before a Flood

- Purchase flood insurance (a 30-day waiting period applies).
- Consider implementing flood proofing measures, such as elevating electrical equipment and major appliances that are susceptible to flooding. (See the section on Flood Proofing Measures).
- Evaluate and correct any drainage issues on your lot.
- Clear obstructions from any storm water systems, such as pipes, ditches, culverts, gutters, downspouts, sediment traps, and washes that carry runoff on or near your property.
- Build an emergency kit and make a family emergency plan that includes a meeting spot in case you're separated.
- Don't forget medicines and special needs required by family members.
- Remember your animals and their needs.
- Protect your home's entrance, back door, and garage with sandbags, which may be available from your local fire department, city or town offices.

### B. During a Flood

- Be aware of all media notifications. Monitor social media, local government notices, online rain gage maps, and weather sites.
- Be aware that flash flooding can happen with little or no notice. If this happens, move immediately to higher ground.
- Be aware of streams, drainage channels, canyons, washes and other areas known to flood suddenly.
- Do not drive into flooded areas.
- Be prepared to evacuate your home.

## C. After a Flood

- Avoid floodwaters; water may be contaminated by oil, gasoline or raw sewage. Water may also be electrically charged from underground or downed power lines.
- Be aware of areas where floodwaters have receded.
- Avoid damaged roadways and be cautious of debris and road obstructions.
- Return home only when authorities indicate it is safe.



Flash floods move quickly - move to higher ground

## D. Emergency information

- For flood watch/warnings and flash flood watch/warnings tune into local TV or radio stations or the local NOAA Weather Radio in the Phoenix area – KEC 94 at 162.550.

### Roadway Safety: Turn Around, Don't Drown

- DON'T drive or walk through flooded roads or moving water. Six inches of moving water can make you fall and two feet or less of water will cause most vehicles to float.
- Be especially cautious at night when flood dangers are harder to see.
- Be aware that the road may be washed out, so floodwaters may be much deeper than expected.
- DON'T drive around barricades; they are there for your protection.
- Stick to designated evacuation routes.



NEVER attempt to cross a flooded roadway or crossing.



Two feet or less of water can sweep away most vehicles.

## 3.0 Managing Flood Risk in Your Community

### 3.1 Roles and Responsibilities of Floodplain Management

Stormwater and floodplain management protects the health and welfare of the public from the impacts of flooding. This is accomplished by identifying flood hazard areas, regulating building activities in a floodplain, and developing and maintaining cost-effective and efficient drainage and flood control systems. Federal, state and local agencies and municipalities – as well as property owners – all have a role in this process.

#### A. Federal

The Federal Emergency Management Agency (FEMA):

- Sets national policy for floodplain regulations and establishes minimum regulatory requirements for flood hazards.
- Administers the National Flood Insurance Program (NFIP) which subsidizes flood insurance rates and provides federal disaster relief to participating communities affected by flooding.
- Identifies and maps flood hazards on Flood Insurance Rate Maps (FIRM) and helps review and adopt new data and maps.
- Assesses community compliance with the minimum NFIP criteria and advises local officials responsible for administering the ordinance to ensure compliance.

#### B. State of Arizona

- Sets state standards for floodplain management.
- Administers the Community Assistance Program and Map Modernization Program.
- Assists communities that participate in the NFIP.
- Works with local, state and federal entities during times of flood emergencies.

## C. Local Governments and Agencies

- Create land use plans that enable and regulate land development.
- Determine whether proposed developments are located in flood hazard areas.
- Require new subdivisions with more than 50 lots to identify flood elevations.
- Review residential subdivision, commercial and industrial plans; issue permits and inspect for compliance.
- Assist in the preparation of floodplain maps.

## D. Property Owners/ Homeowners' Associations

- Maintain drainage facilities and washes on private property, as well as proper site drainage.
- Seek the appropriate permits to build in floodplains.



Managing development in a floodplain is one way the Flood Control District and its municipal partners help minimize potential flooding impacts to residents during large storms.

## 3.2 Managing Flood Risk in Your Community

### A. Floodplain Management Ordinances and Plans

Both the FCD and local municipalities have a role in managing floodplains to control activities that occur in flood-prone areas and reduce property flooding and damages to residents. Floodplains are managed through the adoption of local Floodplain Management Ordinances and Plans, which include: mapping of the Special Flood Hazard Areas (floodplains) within a jurisdiction's boundaries, establishing development requirements for projects within floodplains, reviewing and approving permits for proposed uses within the floodplain and enforcing floodplain violations. The FCD conducts floodplain management and permitting for the unincorporated areas of Maricopa County and 14 incorporated cities and towns, while 10 cities conduct their own floodplain management (see list below).

Local municipalities that participate in the National Flood Insurance Program (NFIP) through FEMA must adopt Floodplain Management Ordinances and Plans. Compliance with community floodplain management plans is a requirement for participation in the NFIP and ensures property owners can purchase flood insurance. Participating communities are also eligible to receive disaster relief for damages from a major storm event.

#### Who is Responsible for Floodplain Management in My Area?

Flood Control District conducts floodplain management and permitting for the unincorporated areas of Maricopa County and the following incorporated cities and towns:

- Buckeye
- Carefree
- Cave Creek
- Chandler
- El Mirage
- Gila Bend
- Guadalupe
- Litchfield Park
- Mesa
- Queen Creek
- Surprise
- Tolleson
- Wickenburg
- Youngtown

The following cities conduct their own floodplain management and floodplain use permitting:

- Avondale
- Fountain Hills
- Gilbert
- Glendale
- Goodyear
- Paradise Valley
- Peoria
- Phoenix
- Scottsdale
- Tempe

## 3.3 Regulating Development and Property Improvements in a Floodplain

### A. Why It's Important

Changes in the watershed can affect drainage and flooding on other properties within that watershed. To minimize the impacts from future development and help protect existing and future residents from flooding caused by other property owners, new development or improvements to existing properties in floodplains is controlled through local regulations.

The Floodplain Regulations for Maricopa County define the rules for development restrictions and permitting requirements necessary to protect the environmental quality and flood control of floodplains. Developers and other private property owners are not prevented from building and making improvements on property in a floodplain. However, there are special requirements for doing so to ensure stormwater runoff doesn't negatively impact the community.



Property owners in a floodplain are not prohibited from building or making improvements to their property, but there are restrictions for doing so to help avoid potential damage to structures or adverse impacts to adjacent properties.

## **B. Potential Impacts of Development and Other Activities in the Floodplain**

Historically, stormwater that was not absorbed into the soil (or used by surrounding vegetation) would typically flow as runoff into nearby washes, arroyos, creeks or streams. Human-induced changes to the area, such as vegetation removal, new roadways, rooftops, barns, and other impervious surfaces are capable of changing the water balance and the natural hydrology of the area. These modifications can result in less rainfall being absorbed naturally into the soil and an increase in stormwater runoff.

Rapid population growth in Maricopa County has expanded the urbanized area through residential and commercial development. Changes in land uses also alters the floodplain and the dynamics of flow, increasing the potential for buildings and infrastructure to be damaged by periodic flooding. As urban development increases, so does the potential for storm water flooding, if not properly managed or regulated.

Urbanization can affect the runoff of storm water as buildings, parking lots and sidewalks replace the natural vegetation that previously absorbed water with impermeable surfaces. Local storm water retention requirements and other development regulations are in place to help minimize this increased runoff from developed areas.

By slowing the water and allowing it more time to be absorbed into the natural ground surfaces, green infrastructure (GI) and low impact development (LID) techniques offer an opportunity to help offset the impacts of increased imperviousness and can assist in maintaining portions of the pre-development hydrology of the area. GI/LID strategies include methods and practices that attempt to mimic natural processes where rain water can be slowed, collected, and delayed close to and eventually - over a long period of time - be filtered back into the ground water system, local aquifers, mimicking the pre-development drainage systems of the area while also providing an irrigation benefit.

The long term results of implementing GI/LID techniques can have direct and tangible benefits to property owners and also provide benefits to the overall community through habitat preservation and enhancement, reduction in soil erosion and sediment transport, and air quality improvements.

An increase in unpredictable precipitation patterns has resulted in more intense but less frequent events can be prepared for with more widespread implementation of GI/LID and floodproofing techniques help to increase the resiliency of whole communities and regions.

## Impacts of Development on Flood Risk Upstream

During a flood, a river or wash flows not only through its normal channel but also along the adjacent floodplain. Any constriction of the natural flow path can 'back-up' the wash and lead to increased flood levels upstream. The construction of homes or other buildings in a floodplain can not only put the development at risk of flooding, but can also increase the flood risk for properties upstream. The same is true of any construction in, or encroachment into, a river or wash channel.

## Impacts of Development on Flood Risk Downstream

Natural or agricultural land is normally able to absorb a considerable portion of any rainfall. Covering such land with buildings, pavement for roads and parking lots, or other impermeable materials, significantly reduces this ability to absorb rainfall, and leads to increased storm water runoff. As a result, large developments, including those away from rivers and washes, can increase flows and the risk of flooding to land and property downstream. A number of smaller developments built up over time can have the same effect.



Pavement and structures on developed land affect how storm water flows and soaks into the ground.

## 3.4 Do's and Don'ts of Floodplain Uses

### A. What are the Building Restrictions Within a Floodplain?

The Flood Control District and local municipalities responsible for floodplain management enforce floodplain regulations, which regulate the location and construction of buildings and other development within designated floodplains. This helps prevent new structures or improvements in the floodplain from causing adverse impacts to other properties upstream or downstream.

- **Finished floor elevation** – The lowest floor in any habitable structure must be elevated at least one foot above the base flood water surface elevation.
- **Materials** – Construction materials below the regulatory floodplain must consist of flood-resistant materials.
- **Erosion hazard setback** – Improvements must be located a safe distance from any regulatory wash. The setback increases with the size of the base flood.
- **Safe Access** – Safe access for standard vehicles must be provided to every lot in a subdivision.
- **Fencing** – Flows cannot be obstructed by fencing within flood-prone areas without adequate openings.
- **Mobile homes** – Manufactured homes have special requirements, such as anchoring.
- **Permitting** – All structures, walls, fences, grading or earth-moving activities within the floodplain require review and approval by Flood Control District or the local municipality responsible for floodplain management.

## B. When Do I Need a Permit?

Before any grading or structural work is done on your property or if the improvement is being done within a public right-of-way or drainage easement, a permit will be required. Depending on the nature of the work and whether the property is located within a floodplain, multiple permits may be needed. Building permits are issued by the local jurisdiction where the property is located. For unincorporated Maricopa County, building permits are issued by Planning & Development.

If your property is located within a floodplain, you must acquire a floodplain use permit from the Flood Control District to make any changes to your property, including:

- Building a new structure or improving an existing structure.
- Installing any type of wall or fencing or other man-made improvements, such as a pool.
- Grading, filling or extracting material.
- Installing drainage improvements, such as berms, ditches or other alterations that have the potential to divert, obstruct or limit flow.
- Excavating material from a wash for any reason, including removing sediment deposited during a flood event.
- Reconstructing eroded channel banks, or constructing erosion protection along existing channel banks.
- Conducting any work within the regulatory floodplain that may divert, obstruct or limit flow.

If a structure on your property was damaged, a permit may be required to repair the damaged structure. Consult with Flood Control District or your local municipality prior to beginning any repairs. Work within a wash may require approval from the US Army Corps of Engineers. Contact the Regulatory Branch at

202-761-5903 or [www.usace.army.mil/Contact.aspx](http://www.usace.army.mil/Contact.aspx).



New development or improvements to a property located in a floodplain require a floodplain use permit, in addition to any building permits issued by the local jurisdiction or Maricopa County Planning and Development.

## C. What Home Improvements Can I Make Without a Permit?

Minor activities, such as clean-up of deposited vegetative or flood debris, clean-up of fine sediment in the wash over-bank, reconstruction of at-grade driveways, or minor modifications to deposited sediment may occur without permits, although consultation with Flood Control District, Maricopa County Planning and Development or the local municipality is recommended. Unauthorized work not only has the potential to adversely impact your neighbors and create a liability to you, but may also increase the hazard to you and your own property if done improperly.

## D. Obtaining Permits and Inspections

The Flood Control District issues floodplain use permits and conducts inspections for 14 incorporated cities and towns. The other communities in Maricopa County perform their own floodplain management activities and permitting. Depending on where your property is located, you will follow one of three permitting scenarios below when obtaining a permit to develop or improve a property in a floodplain.

1. If your property is located in unincorporated Maricopa County, visit the One-Stop-Shop to start the permitting process, a central location where the partner agencies that issue permits are routed a copy of the application for review.

An application is available at [www.maricopa.gov/Planning](http://www.maricopa.gov/Planning) and at 501 N. 44th St., Ste. 200, Phoenix, AZ 85008, 602-506-3301.

2. If your property is located in a community that conducts its own floodplain management, building and floodplain use permits are processed by the respective community and a permit from the county is not needed.
3. If your property is located in a community in which the Flood Control District handles their floodplain management, visit the appropriate city/town location to start the permitting process. If your property is in a floodplain, you will also need to obtain a floodplain use permit from the Flood Control District prior to obtaining your building permit.

## E. What are the Restrictions for Building on a Flood-Prone Lot?

New, livable structures are not allowed in the floodway portion of a mapped floodplain. Some types of improvements, such as shade structures, fencing, and cellular towers, are allowed if an engineer can demonstrate that the improvement does not raise the water surface elevation. Construction in a floodplain is allowed with restrictions.

# 3.5 Regulating Development and Property Improvements in a Floodplain

## A. Reporting A Floodplain Violation

If a neighbor is blocking or altering a wash or re-grading, excavating, or dumping material in a regulatory floodplain without a permit, it may cause adverse impacts to adjacent properties and constitute a violation of the local Floodplain Ordinance. A floodplain violation is any unauthorized structure, fill or other development within a delineated floodplain regulation. A violation occurs when any unpermitted activity diverts, obstructs, impedes or otherwise changes the regulatory floodplain and creates a hazard to life or property.

Complaints of potential floodplain violations should be reported to the FCD (if within unincorporated areas of Maricopa County) or to your local municipality’s floodplain administrator for investigation. Anyone making a complaint may do so anonymously.

If the problem is in a regulatory floodplain, and you think it may be a violation of the floodplain ordinance:

- Call the Flood Control District or your community’s floodplain manager.
- Document the activity.
  - Note the time, date and exact location.
  - Take pictures, draw maps, write down license plate numbers and descriptions of vehicles.
  - Obtain the property address or legal description or Assessor Parcel Number.

The information you provide helps us to resolve your complaint faster. Once a possible violation has been reported, an inspector will review the area. If a violation has occurred, the property owner or involved party in question will be formally notified and requested to take corrective action. Civil court action has been required in some instances.

### Who To Call In Your Area

Unincorporated Maricopa County (Flood Control District)	Goodyear	623-882-7979
Flood Control District	Paradise Valley	480-348-3693
602-506-2419	Peoria	623-773-7210
Planning and Development	Phoenix	602-262-4960
602-506-3301	Scottsdale	480-312-2356
Fountain Hills	Tempe	480-350-8288
480-816-5100		
Gilbert		
480-503-6815		
Glendale		
623-930-3656		

*\*Residents of unincorporated Maricopa County report violations to Maricopa County Planning and Development and not to Flood Control District.*

## 3.4 Maintenance Responsibilities for Flood Control and Drainage Infrastructure

### A. The Importance of Flood Control and Drainage Structures

While the FCD owns and maintains numerous regional flood control structures throughout Maricopa County, the majority of smaller drainage facilities – such as culverts, ditches and retention basins – are owned by others. Some of these are publicly-owned within a city, county, or state right-of-way (such as along a roadway or freeway), while others are privately owned by homeowners associations (such as community greenbelts used as retention basins) or individual property owners.

These drainage facilities serve an important function in protecting properties against flooding, and also retaining or conveying storm water throughout a watershed. If these drainage structures are not properly maintained, they can actually cause flooding – rather than reducing or preventing it.

The following information is intended to help private owners and homeowners associations understand their responsibilities for maintaining proper drainage.

### B. Who is Responsible For Maintaining Drainage Facilities in My Neighborhood?

It depends on who owns the facilities. Typically your local jurisdiction or homeowners association (HOA) has maintenance responsibilities for drainage in your neighborhood.

- Consult the plat, the grading and drainage plan or the covenants, conditions and restrictions (CC&Rs) for the subdivision. These should outline maintenance responsibilities.
- It is generally the responsibility of the individual property owner to maintain the portion of the drainage channel or wash on his or her property.
- For regional drainage facilities or large washes, the HOA, city or county may be responsible for maintenance.

## C. How Do I Find Out If I Have a Drainage Easement On My Property?

- You may be able to obtain a copy of the dedicated drainage easement for most significant washes or channels at the city or county records department.
- In addition, request a copy of the current title report or plat of your lot or subdivision, which will show the location and boundaries of any easements. Plats are available on the Maricopa County Assessor's website at: [www.mcassessor.maricopa.gov](http://www.mcassessor.maricopa.gov) if searching by parcel or the County Recorder's website at [www.recorder.maricopa.gov/internetmaps](http://www.recorder.maricopa.gov/internetmaps) if searching by the Recorder's book and page number.



Pavement and structures on developed land affect how storm water flows and soaks into the ground.

## 4. Glossary of Terms

**100 Year Storm:** A storm that has a 1% chance of happening in any given year.

**ADWR:** Arizona Department of Water Resources

**ARS:** Arizona Revised Statutes

**Aquifer:** A porous deposit of rock, such as sandstone, containing water that can be used to supply wells.

**Bajada:** A broad slope of alluvial material at the foot of an escarpment or mountain.

**Berms:** Mounds of soil used to retain stormwater or to direct its flow.

**Bimodal rainfall patterns:** In Arizona we typically receive the majority of our rain events in either the winter months (December - February) or during the monsoon season (July - September)

**Cistern:** A tank used to store collected rainwater.

**Downspouts:** Vertical pipes that drain stormwater downward from the gutters.

**Flash Flood:** Rapidly rising water in a wash or river that is usually caused by heavy rainfall.

**French Drain (Rock Chimney):** Gravel filled hole or trench placed so that stormwater can seep in.

**FCDMC:** Flood Control District of Maricopa County

**GI:** Green Infrastructure

**Gutters:** Channels along a roof's edge to catch and direct stormwater.

**Impervious:** Not allowing water or other liquids to pass through a surface.

**Infiltration:** The movement of water through the soil surface into the soil.

**LID:** Low Impact Design

**Monsoons:** A seasonal pattern of wind and rainfall.

**Pervious:** Allowing the passage of water or liquids through a surface.

**Precipitation:** Water falling from the atmosphere in the form of rain, snow, sleet, or hail.

## Glossary of Terms Continued

**P & D:** Planning and Development

**Run-Off Coefficient:** An estimated proportion of rainfall that “runs off” a specific surface, depending on how much water can be absorbed.

**Soil:** Composed of gravel, sand, silt, and clay, soil is the growing medium for plants and can be a great place to store captured storm water.

**Stormwater Runoff:** Rainwater that hits the ground and flows over the earth’s surface.

**Swale:** A long shallow trough between two areas of higher ground in the yard.

**Water Cycle:** The natural sequence through which water passes into the atmosphere as water vapor precipitates into earth in liquid or solid form, and ultimately returns to the atmosphere through evaporation.

**Water Harvesting:** Collecting and putting rainwater or stormwater to beneficial use.

**Watershed:** An area of land that sheds water and directs it downhill to a particular watercourse or point.

## 5. Sources

Information in this resource guide was compiled from multiple sources. These sources are listed below.

### Helpful Resources

- 2018 Flood Facts (Flood Control District of Maricopa County)
- Homeowners Guide to Drainage (City of Scottsdale)  
<https://www.scottsdaleaz.gov/Asset10072.aspx>
- City of Phoenix 2014 Seamless Service Directory  
(<https://www.phoenix.gov/piosite/Documents/047076.pdf>)

### How Flood Risk is Determined

- 2018 Flood Facts (Flood Control District of Maricopa County)
- Definitions of FEMA Flood Zone Designations, CoreLogic

### Floodplain Information Sources

- Homeowners Guide to Drainage (City of Scottsdale)  
<https://www.scottsdaleaz.gov/Asset10072.aspx>
- <https://www.maricopa.gov/3942/GIS-Mapping-Applications>
- <https://www.maricopa.gov/716/Frequently-Asked-Questions>

### Challenging or Revising a Floodplain Determination

- <https://www.maricopa.gov/716/Frequently-Asked-Questions>
- <http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/mt-2-application-forms-and-instructions>

### Maintaining Proper Drainage on Your Lot

- City of Scottsdale Homeowners Guide to Drainage  
<https://www.scottsdaleaz.gov/Asset10072.aspx>

### Flood Insurance

- 2018 Flood Facts (Flood Control District of Maricopa County)  
<https://www.maricopa.gov/DocumentCenter/View/12589/Flood-Facts-CRS-Newsletter>
- [www.floodsmart.gov](http://www.floodsmart.gov)

## **Flood-Proofing**

- Mitigation Ideas for Reducing Flood Loss (FEMA publication October 2010)  
[https://www.fema.gov/media-library-data/20130726-1756-25045-8598/protecting\\_home\\_book\\_508compliant.pdf](https://www.fema.gov/media-library-data/20130726-1756-25045-8598/protecting_home_book_508compliant.pdf)

## **Flood Safety**

- 2018 Flood Facts (Flood Control District of Maricopa County)  
<https://www.maricopa.gov/DocumentCenter/View/12589/Flood-Facts-CRS-Newsletter>

## **Managing Local Floodplains**

- <https://www.maricopa.gov/716/Frequently-Asked-Questions>

## **Regulating Development and Improvements in a Floodplain**

- <https://www.maricopa.gov/716/Frequently-Asked-Questions>
- <http://www.usace.army.mil/>

## **Floodplain Violations - Enforcement and Reporting**

- <https://www.maricopa.gov/DocumentCenter/View/31723/Floodplain-Regulations-for-Maricopa-County-Final>
- 

## **Maintenance Responsibilities for Flood Control and Drainage Infrastructure**

- Homeowners Guide to Drainage (City of Scottsdale)  
<https://www.scottsdaleaz.gov/Asset10072.aspx>

## **Wash Maintenance**

- City of Scottsdale Homeowners Guide to Drainage  
(<https://www.scottsdaleaz.gov/Asset10072.aspx>)
- Balancing Nature and Safety: A Homeowners Guide to Wash Ownership and Maintenance (City of Scottsdale)  
(<https://www.scottsdaleaz.gov/Asset10072.aspx>)

## **Water Conservations**

- Water Use It Wisely <https://wateruseitwisely.com/100-ways-to-serve/>
- Arizona Municipal Water Users Association (AMWUA)  
<http://www.amwua.org/what-you-can-do>
- Brad Lancaster's website (Author of several books for water harvesting in Arizona)  
<https://www.harvestingrainwater.com/>