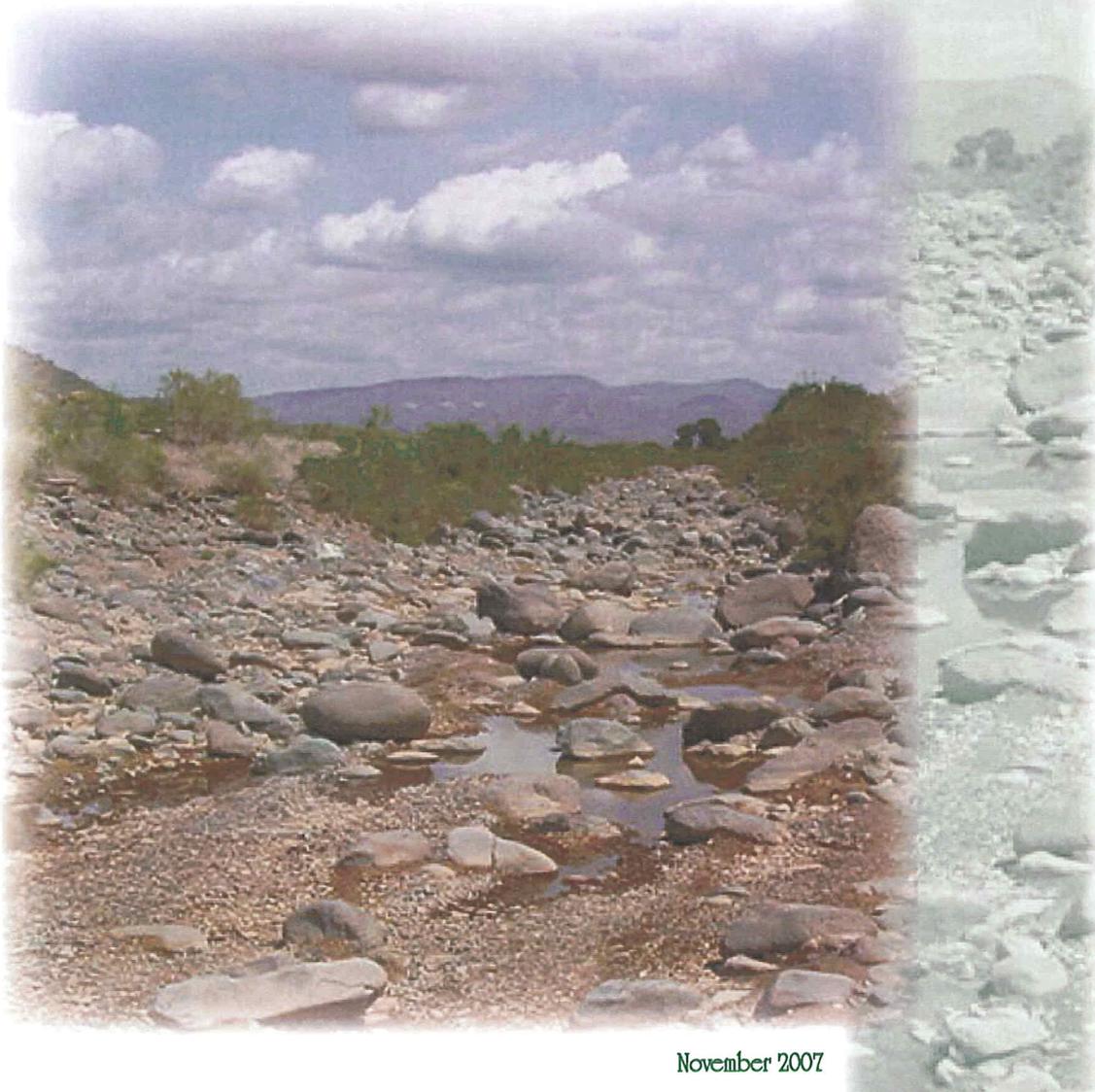


## **APPENDIX G    DRAINAGE GUIDELINES**

# Drainage Guidelines

## **BEST MANAGEMENT PRACTICES**

A Construction Guide for Development of  
Subdivisions and Individual Lots in the  
Town of Cave Creek



November 2007



Settled 1870 - Incorporated 1986



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## INTRODUCTION

The rural feel and the natural elements in the Town of Cave Creek (Town) allow for a unique living experience. As the Town grows, the appearance of new developments will play an important role in the preservation of these characteristics. The information contained herein describes some of the important drainage considerations that should be made prior to construction. For additional information on drainage and grading issues, please consult the *Grading and Drainage Design Guidelines for the Town of Cave Creek*.



## CURRENT REQUIREMENTS

Washes are a key element within the Town and lend to its character. However, to ensure the safety of people, structures, and to preserve the integrity of the washes, a number of rules and permitting requirements must be considered in the planning stages of a project. Design standards, in conjunction with governing specifications and ordinances at the federal, state, county and Town level, guide development to ensure safety and preserve aesthetic values. The following federal, state, county, and Town documents should be reviewed prior to developing any project.

### **Federal (U.S. Army Corps of Engineers and Federal Emergency Management Administration [FEMA])**

- Clean Water Act (CWA) Section 404 permit and 401 certification is required if removing or adding fill material to a jurisdictional area
- Construction that modifies the floodplain within a Special Flood Hazard Area (SFHA) requires a Letter of Map revision or amendment from FEMA

### **State (Arizona Department of Environmental Quality)**

- National Pollution Discharge Elimination System (NPDES) permit and Storm Water Pollution Prevention Plan (SWPPP) are required for disturbances of one or more acres of ground
- CWA Section 401 certification
- Drywell registration

### **County (Flood Control District of Maricopa County [FCDMC])**

- Floodplain Use Permit for improvements within any FEMA delineated floodplain
- Drainage Design Manual for Maricopa County, Arizona, Volume I – Hydrology and Volume II – Hydraulics required for drainage design purposes

### **Town of Cave Creek**

- Zoning and Subdivision Ordinances
- Town ordinances govern land including grading and drainage
- Grading and Drainage Design Guidelines for the Town of Cave Creek

## AT-GRADE CROSSINGS

Most of the wash crossings in the Town are “at-grade” crossings. That is to say, they allow all water flowing in the wash to pass over the top of the roadway. This is true for both publicly owned and privately owned wash crossings. At-grade crossings may be either paved or unpaved. This method of crossing the numerous washes in the Town is effective in part from the low initial cost and it imposes the least visual impact upon the natural wash aesthetics. There are, however, several significant design components that need to be considered in the proper design of an at-grade crossing, including maintenance and access during flow events.



### MAINTENANCE

Flood waters in natural desert washes carry significant amounts of sediment and debris. This is in part due to the particularly steep slopes and relatively high velocities of the washes found within the Town. The energy in the flowing water creates a natural process of eroding the stream channel bottom and sides, conveying the eroded material (also known as alluvium) downstream. At wash crossings, the flow velocity often slows down, depositing the loose material onto the roadway. This results in a layer of sand or gravel on the road that requires follow-up maintenance for removal.

Natural washes may degrade over time, and this process is hastened by large flow events. Degradation of a wash usually includes a lowering of the wash bottom. “Head-cutting” is the lowering of the wash bottom, as the degradation migrates upstream. When head-cutting reaches an at-grade crossing it may destroy the crossing, sometimes during a single event. The result is an impassable surface that may be covered in water or hidden by debris.

### **ACCESS DURING FLOW EVENTS**

At-grade crossings are effective in the Town due to the low initial expense and their ability to function during dry periods, which are most days of the year. On the infrequent occasions that washes are flowing, they should not be crossed due to the inherent hazards of becoming stranded or swept downstream.

**Most vehicles lose grip with the road in less than 6 inches of flowing water, and most vehicles can become buoyant in 2 feet of water or less.**

Nearly half of all flash flood fatalities are automobile related. Most occur when people drive into flooded roadways, particularly at night or when driving on unfamiliar roads.

### **DESIGN RECOMMENDATIONS**

At-grade crossings should be designed to reduce the need for routine maintenance while promoting a clear and structurally sound roadway surface. Elements of a properly engineered, at-grade crossing include:

- A concrete surface to keep the shape of the crossing and to provide a base elevation for sediment removal.
- A constant, one-way cross slope throughout the entire crossing of at least two percent and preferably four percent, to reduce the accumulation of sediment on the roadway.
- Upstream and downstream cut-off walls with aprons shall be provided to minimize the effects of headcutting and erosion.
- Concrete ribbon curb on the upstream edge of the crossing to prevent damage to the roadway surface.
- For public crossings, caution signs shall be added, where appropriate, to warn motorists not to cross when flooded.
- Public crossings should be designed such that adequate sight distance and design speeds accommodate the resulting at-grade roadway profile.

## **CULVERTS**

Wash locations with naturally occurring steep banks, limited right-of-way, or large peak discharges, will require a pipe culvert crossing, rather than an at-grade crossing. Culverts for Major Washes (a water course with an officially delineated Flood Hazard Zone or any wash having a drainage basin of ten acres or larger) shall pass stormwater under the road without overtopping during the 100-year storm event. Specific requirements for the design of culverts, i.e. size, length, slope, and material are defined in the *Maricopa County Hydraulics Manual*, and in

the *Grading and Drainage Design Guidelines for the Town of Cave Creek*. Within the Town, the minimum allowable culvert size is 24 inches in diameter.

All culverts are to be installed with end treatments on both the upstream and downstream ends. End treatments may consist of either manufactured end sections or headwall sections. End treatments appropriate for the Town include riprap erosion protection constructed from local rock surrounding the manufactured section (*Figure 1*), or concrete headwalls faced with either natural stone or painted to blend with the natural desert (*Figure 2*). All end sections are to be constructed in accordance with

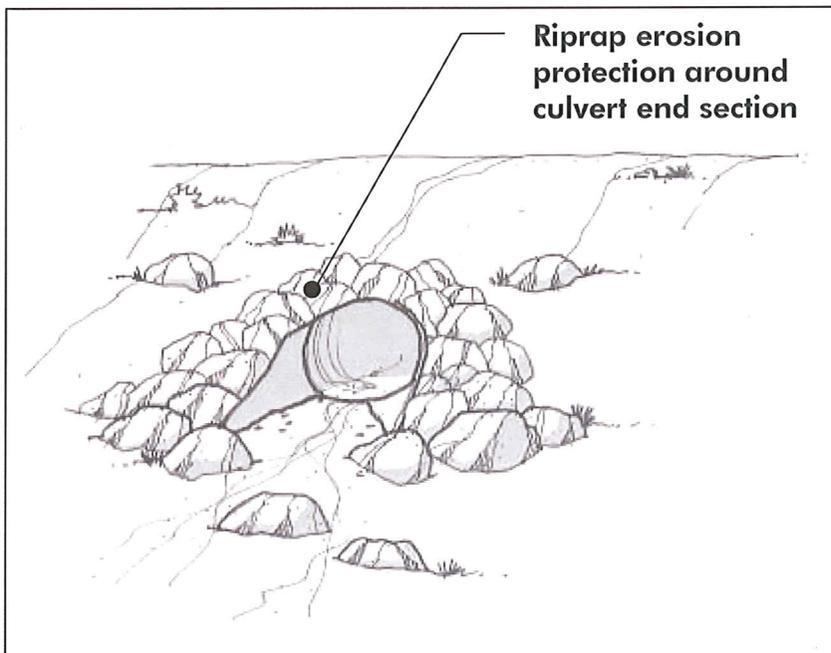


Figure 1: Manufactured End Section

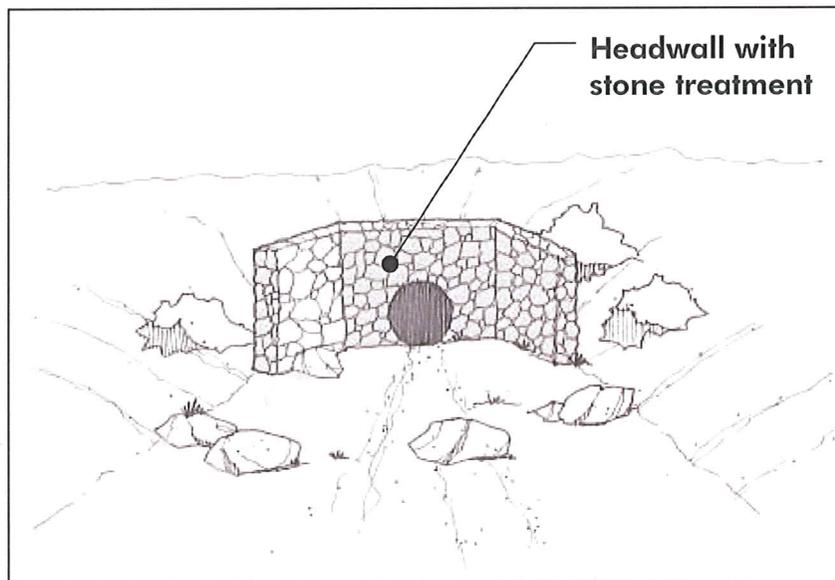


Figure 2: Headwall

*Maricopa Association of Governments Standard Details*. In addition, hand rail treatments shall be painted in a desert complementary color.

Culvert designs shall be prepared under the direction of, and sealed by, an Arizona registered Civil Engineer for approval by the Town Engineer. Culverts are not only designed to pass flows from the wash, but must also be designed to accommodate the sediment that is conveyed in the water for all storm events up to and including the 10-year storm event. Culverts must also be structurally designed to accommodate traffic loading.

## **UTILITY CROSSINGS**

In addition to roadway crossings, it is sometimes necessary for utilities to either cross or be located along the length of a wash. Publicly owned utilities are contained within public right-of-way or utility easements and are designed

and constructed by the company or agency providing the utility service. These may include:

Water supply pipelines	Cable television
Sewer lines	Telephone
Buried electric lines	Gas lines

Private utilities such as on-lot water, electric, irrigation, etc. should be buried below the anticipated scour depth. Cover may be removed from the utility by weathering over time.

## **DRIVEWAYS**

Driveways may extend from the public right-of-way to serve one landowner, or in some cases, extend across private property to serve more than one landowner. Driveways may or may not be paved. It is important that the design of the driveway takes into account all the minor washes and minor flowpaths that may exist on the property. A minor wash is defined as any water course having a drainage basin of less than 10 acres. These are sometimes not readily observable, but become clearly evident when storm runoff occurs. If not accounted for, the driveway may inadvertently intercept stormwater and direct it towards a house or garage.

The elevation of the finished floor for a structure not located in a FEMA Special Flood Hazard Area should be at least 14 inches above the highest adjacent grade on the lot. Ignoring driveway grading may cause flooding in the structure for an otherwise safe building, as shown in *Figure 3.1*. Suggested alternatives include the elevation of the elevation of the Finish Floor, sloped driveways, and adequate drainage capacity as shown in *Figure 3.2* to reduce the risk of structure flooding.

Driveway crossings of washes may be at-grade or contain structures to convey the flow. If a culvert is provided, the design shall allow for storm flows in excess of the culvert capacity to flow over the driveway and return to the wash, without being diverted.

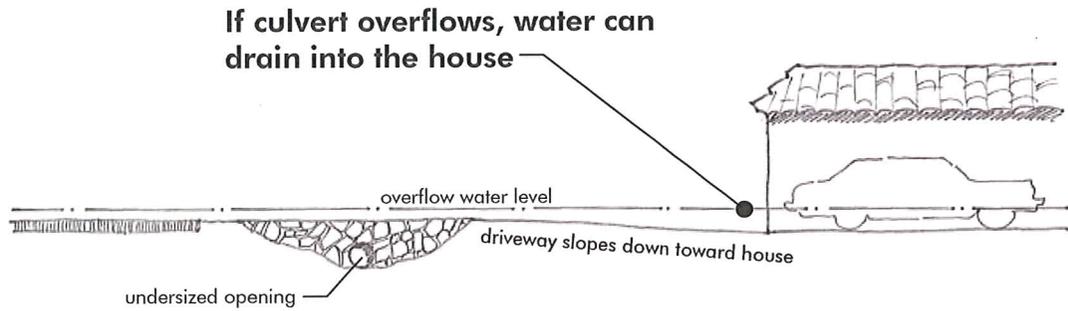


Figure 3.1: What Not To Do

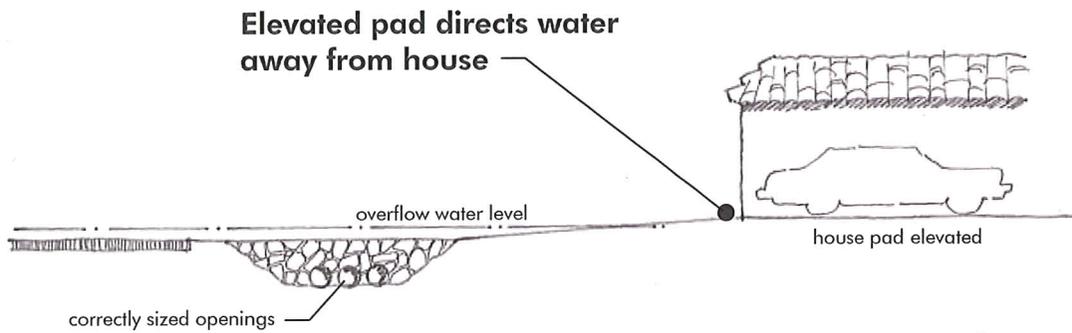


Figure 3.2: What To Do



## **EROSION HAZARD SETBACK LIMITS**

Erosion hazard setback limits (EHSL) are areas adjacent to or within major washes where the placement of structures is not allowed without engineered erosion protection (*Figure 4 and Example Photo next page*). These limits are established to protect structures from erosion-related damages. Early in the planning stages of a project, review of the EHSL shall be conducted to determine the necessary level of effort for protecting the proposed development. The design of a property shall avoid placing habitable structures, retaining walls, pools, driveways or other permanent types of improvements within the EHSL. All encroachments of the determined EHSL will require some form of structural erosion control measure. Examples of structural erosion control measures include loose or grouted riprap, retaining walls, gravity walls, roller compacted concrete, etc. General design guidelines for erosion control structures are found in the *Grading and Drainage Design Guidelines for the Town of Cave Creek*.

Refer to the *Geomorphic and Sedimentation Engineering Report* prepared by JE Fuller for Equilibrium Slope Analysis and Erosion Hazard Zones prepared for Cave Creek and its tributaries in the eastern and western portions of the study area.

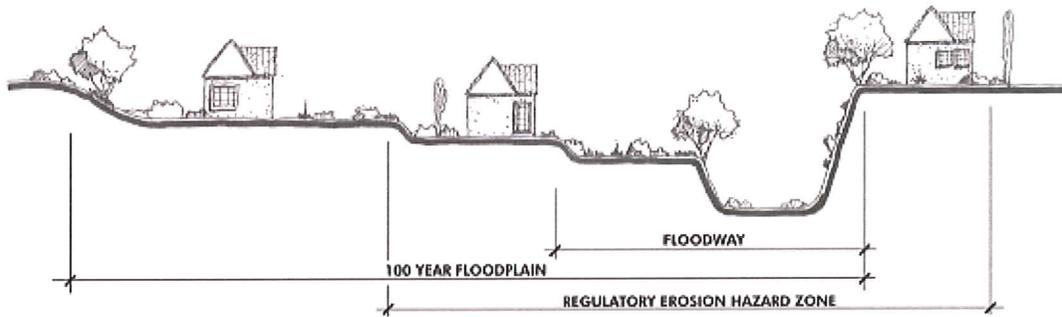
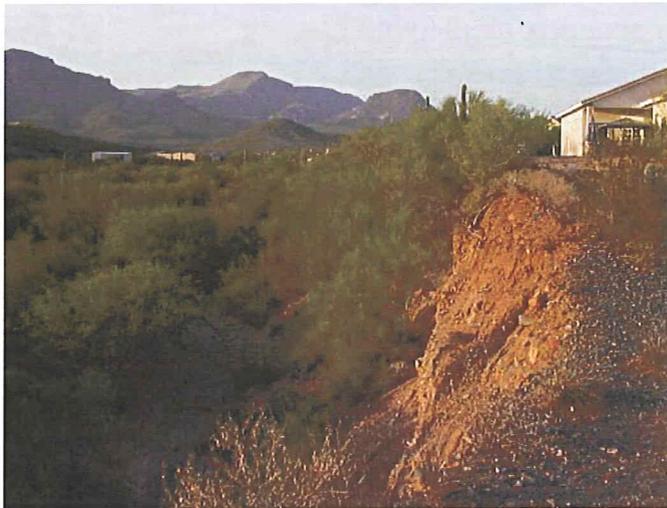


Figure 4: Erosion Hazard Setback Limits



Example: Existing Wash Bank Near Structure

## SEDIMENTATION AND SCOUR

The Town of Cave Creek sits on a landform in the foothills region of the Sonoran high elevation desert that is characterized by steep slopes, rock outcroppings, and significant vegetation. The soil and rock stability is not well established and is subject to movement during small to moderate storm events. The loose soil and rock material can become a potential maintenance problem if not accounted for in the design of drainage facilities.

Areas other than washes that are disturbed can become susceptible to sedimentation and scour problems as a result of grading or construction activities if not properly restored. Therefore, stabilizing soils in disturbed areas is required to prevent erosion of the soil. Some common

methods of managing sedimentation and soil stability include:

SEDIMENT CONTROL

Organic filter barrier  
Sand bag barrier  
Check dams  
Silt fence  
Temporary sediment basins

EROSION CONTROL

Erosion control mats  
Dust control  
Diversion dikes (see photo below)  
Drainage swales  
Outlet protection  
Flexible bank protection



*Example: Diversion Dike*

To minimize sedimentation and scouring during construction, the following measures shall be followed:

- All applicable erosion and sediment control practices shall be in place prior to any grading operation and/or installation of proposed structures or utilities.
- All applicable erosion and sediment control practices shall be left in place until construction is completed and /or the area is stabilized.
- The site shall, at all times, be graded and maintained such that all stormwater runoff is diverted to sediment control facilities, preventing soil erosion.

- Off-site sediment disturbance may require additional control measures to be determined by the Town Engineer, prior to any construction operations.
- Maximum cut and fill slopes of an exposed surface shall not be constructed steeper than 3:1 and 4:1 respectively, unless surface stabilization measures are taken. Stabilization methods should be approved by the Town Engineer, prior to any construction operations.

## **EROSION CONTROL**

The Town of Cave Creek is subject to high levels of erosion due to steep slopes and mild to no vegetation in certain locations. Soil at embankments, roadway crossings, and within the washes may be eroded creating a potential hazard. Suggested erosion control elements include the following:

- Flexible bank protection (e.g. rock riprap )(see example photo and *Figure 5* next page)
- Geosynthetic erosion control mattresses
- Gabion baskets (see example photo next page)
- Articulated concrete block mattresses
- Concrete
- Cement stabilized alluvium
- Mechanically stabilized earth (MSE) walls

Prior to installation of any erosion control protection, an Erosion Control measure analysis shall be conducted by an Arizona registered Civil Engineer for approval by the Town Engineer.



Example: Flexible Bank Protection



Example: Gabion Baskets

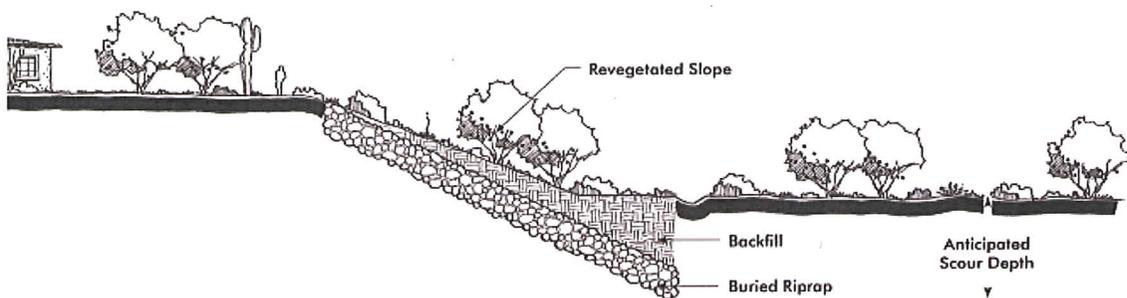


Figure 5: Buried Riprap



## **ON-LOT DEVELOPMENT AND DOWNSTREAM IMPACTS**

Water flow within a lot should be considered when planning on-lot development. Finished floors of structures need to be elevated in comparison to adjacent grades. For structures within mapped floodplains, finished floor elevations must be elevated at least 24 inches above the 100-year water surface elevation. For structures that are not within mapped floodplains, the landscape surrounding the structure must accommodate drainage from the 100-year storm while maintaining 100-year water surface levels at least 6 inches below the finished flood elevation. In addition, the grade surrounding a structure must drain away from the base of the structure, dropping a minimum of 6 inches in the first 10 feet.

The method in which water leaves a lot that has been altered by grading can adversely affect downstream properties. Therefore, when grading alters the natural drainage of a property, historical drainage must be maintained at the on-lot property boundary. This includes drainage location, volume, velocity, sediment yield, and the direction of flow from the property.

No property wall shall be constructed as to prevent the discharge from the 100-year storm event through any parcel within the Town. Any property walls constructed within or across a wash shall utilize a system to accommodate the conveyance of water. All wall designs shall be approved by the Town Engineer prior to construction.

## **STREAM BANK VEGETATION**

While disturbance of stream banks should be avoided, vegetation is an effective tool for stabilizing soil. Indigenous materials should be used, either salvaged from

other areas of construction disturbance or brought in from an off-site nursery. Chapter 12 of the Town Zoning Ordinance provides a listing of approved materials. Spacing and variety of species used should reflect adjacent areas and blend with the natural environment.

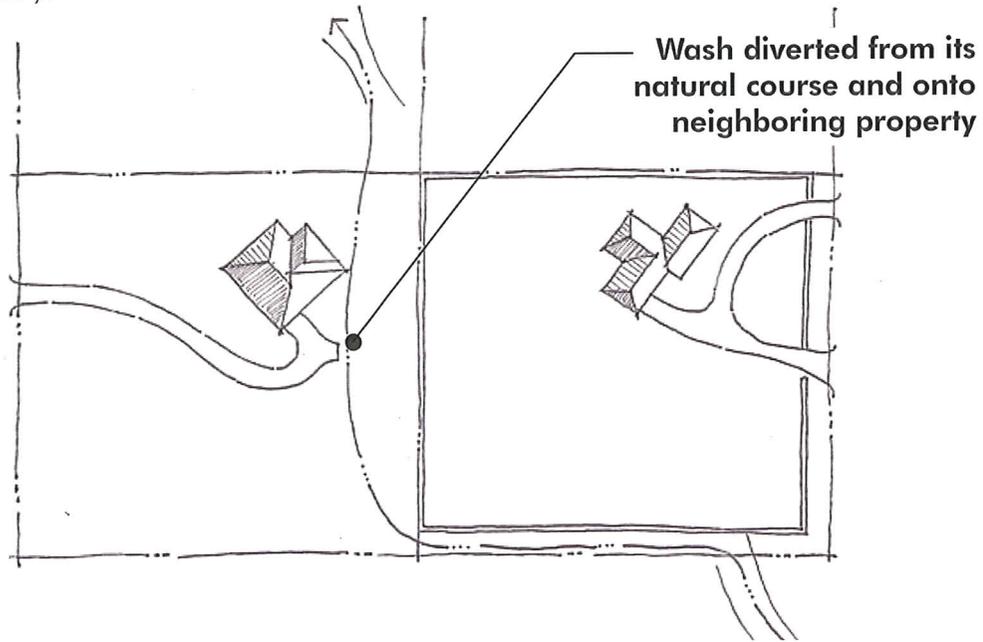
## **FENCES AND WALLS**

The Town of Cave Creek recognizes the increased construction of fences and walls for property owners and large developments. To prevent flooding damage and the diversion of flow upon adjacent property owners, the following design criteria must be met.

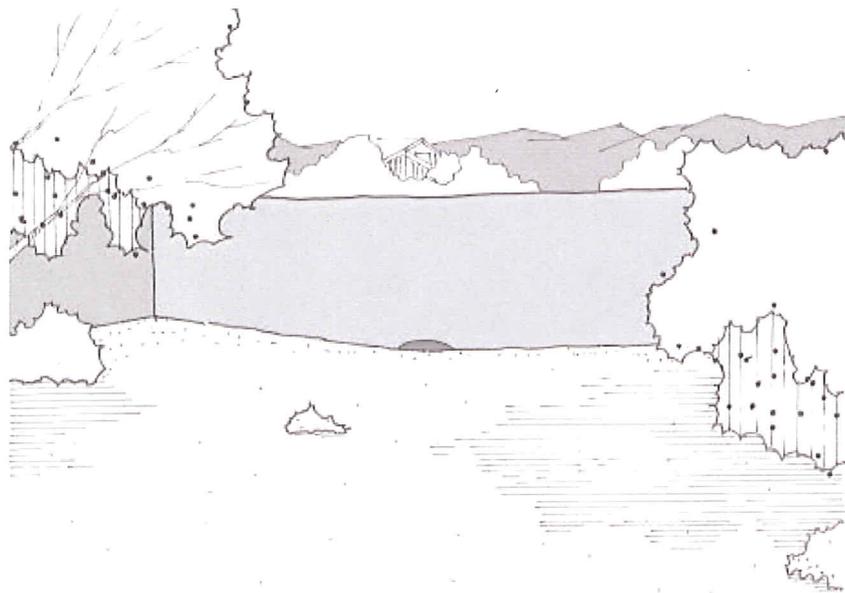
- Walls and fences shall comply with the use, size, and type as summarized in the Town Zoning Ordinances.
- Perimeter or landscape walls must not block natural drainage paths unless provisions have been made for conveying the drainage with sufficient scour protection.
- Walls must be capable of allowing sheet flow, rill flow, and otherwise uncontained flooding that may impact the wall to pass through.
- Walls crossing a Major Wash require a detailed hydraulic and scour analysis report prepared by an Arizona registered Civil Engineer for approval by the Town Engineer.

For additional information, refer to the Town of Cave Creek General Plan 2005, Section 8, Subsection B, Policies 1 and 2.

Below in *Figures 6.1a* and *6.1b* are examples of what not to do. In these examples a wall has been constructed that either prevents flow from continuing the natural drainage path or the capacity of the opening is inadequate for the flow received and is ultimately redirected around the property.



*Figure 6.1a:* Water is diverted onto a neighboring property after walls are built across wash without having properly sized openings.



*Figure 6.1b:* A wall shown with improper openings.

Below in Figures 6.1c and 6.1d is are examples of what to do. In these examples, a wall has been constructed with sufficient capacity to convey the flow along the natural drainage path or walls are not constructed across a wash.

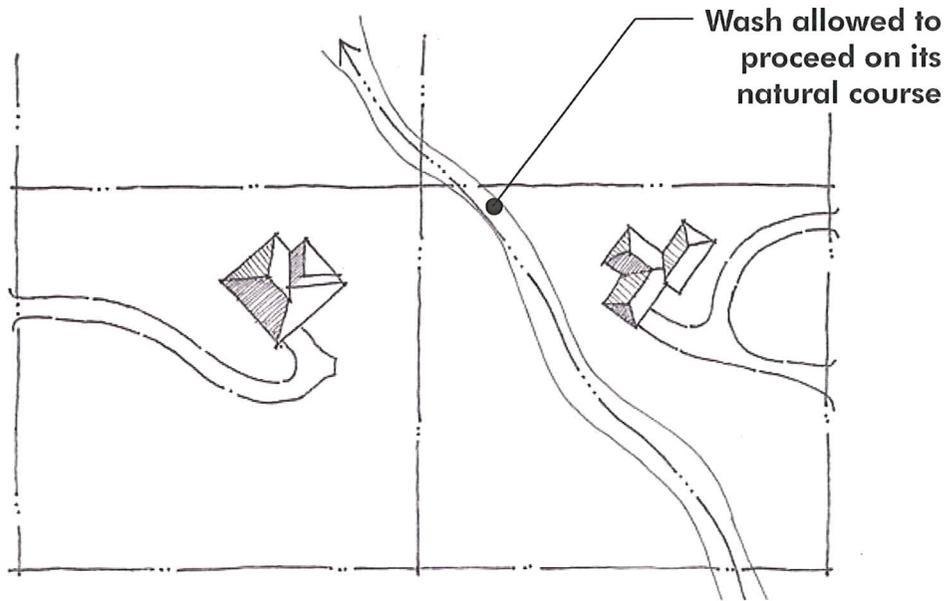


Figure 6.1c: Water is allowed to proceed along its natural course if there are no obstructions or walls have adequately sized openings.

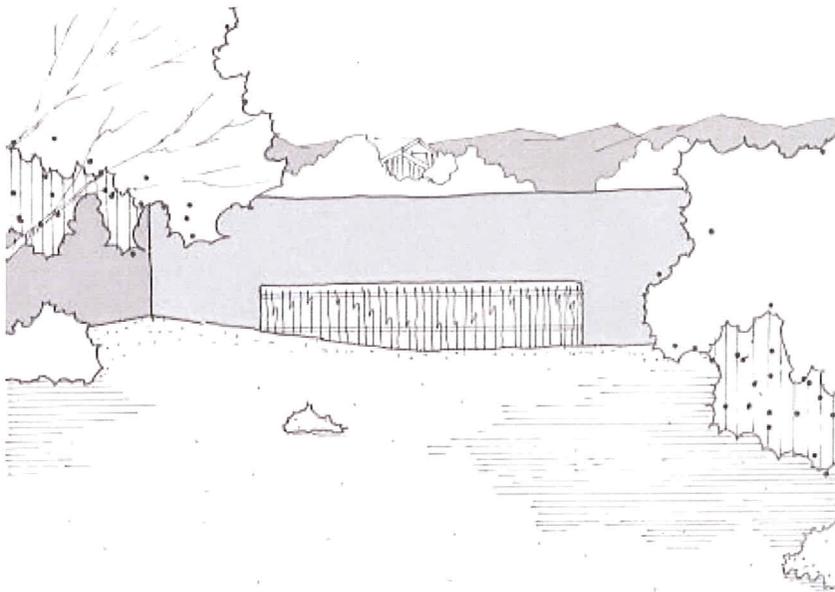


Figure 6.1d: A wall shown with proper openings. Openings shall be sized for proper capacity by an Arizona registered Civil Engineer and approved by the Town Engineer.

## **CHANNEL RESTORATION**

Construction-related disturbances can make it necessary to stabilize and restore channels. Riprap is a common treatment which can be improved both functionally and aesthetically when coupled with vegetation. *Figure 5* on page 15 depicts a wash bank with a revegetated slope over buried riprap. Channel restoration efforts should reflect the undisturbed surrounding area in material and composition. If landscaping materials or channel linings are used, they should be inlaid below the design bottom of the channel so that the finished elevation of the treatment is equal to the design finished grade elevations of the channel.

## **CONSTRUCTION REQUIREMENTS**

Any number of permits or approvals from federal, state, county or local authorities may be necessary depending on the scope and potential impacts associated with an improvement. Prior to the commencement of grading, grubbing or permanent improvement work, all engineering plans are required to have been approved by the Town Engineer. Building permits are required prior to construction of any temporary or permanent structure. All floodplain and erosion setback analyses shall be prepared under the direction of, and sealed by, an Arizona registered Civil Engineer.

## **FINISHED FLOOR ELEVATIONS**

To reduce the risk of structures flooding, minimum finished floor elevations have been established. While the limitations vary, structures occurring both within and outside the Special Flood Hazard Area (SFHA) are subject to these restrictions. Outside of the SFHA, all finished floors must be a minimum of 14 inches above the highest adjacent grade and/or the adjacent ultimate lot outfall. Within the SFHA, the risk of structures being exposed to flood flows is higher and it is required that all finished floor elevations be set at a minimum of 24 inches above the Base Flood Elevation (BFE) identified on the FEMA FIRM panel that covers the project site.

## **RETENTION FOR SUBDIVISIONS**

In order to help keep pollutants out of watercourses and to account for the increased amount of runoff occurring from site development, it is required that all new subdivision developments provide stormwater storage for runoff generated by the 100-year, 2-hour storm event. For subdivisions with lots less than one acre in area, storage shall be located in common tracts of land which may be dedicated to and maintained by the Home Owners Association. Multiple storage basins may be necessary to capture flows from the site. All basins must utilize a maximum ponding water depth of three feet within the storage basin(s).

Once the storm has passed, water must be able to leave the retention/detention area within 36 hours. This is required to minimize nuisances such as odors and insects. Acceptable methods of disposing of water include gravity outfalls through the use of culverts or pipes, natural percolation, drywells and pumps. The method used shall 1) be prepared according to the *Grading*

and *Drainage Design Guidelines for the Town of Cave Creek*, and 2) be reviewed and approved by the Town Engineer.

Stormwater storage areas shall be attractive in appearance, and replicate the natural desert landscape as closely as possible. This can best be accomplished by contouring sides and bottoms of the basins to enhance appearance through varied and naturally appearing slopes. The use of native materials in the construction of all basins is also encouraged.

## **SETBACKS FROM MAJOR WASHES**

The flow of water through a desert wash can be very swift, strong, and dangerous. In order to protect the health, safety and welfare of the people living within the Town of Cave Creek numerous stormwater management strategies have been developed. Setting structures and improvements away from washes is one component of the Town's comprehensive stormwater management program. Prior to construction along a major wash, the 100-year floodplain should be determined through a SFHA, if not already delineated by either FEMA, FCDMC, or the Town. The Town keeps records of major wash delineations.

If an erosion hazard setback has not already been delineated, then an erosion setback analysis compliant with the Erosion Hazard Setback Guidelines for the Town of Cave Creek shall be performed and delineated by an Arizona registered Civil Engineer for Major Washes subject to disturbance.

In addition to conveying water, washes provide corridors for wildlife movement. For minor washes, development shall be set back a minimum of 20 feet from the top of the

wash bank to allow the animal travel corridors to remain uninterrupted.

## **FILL IN WASHES**

In general, placing fill within a wash is not allowed (see Arizona Revised Statute below). Washes shall not be used to store construction waste, landscaping waste, manure, machinery, etc. In certain instances, fill may be allowed. Fill may be acceptable for the installation of culverts, minor wash crossings, utility installations and embankment restoration for repair of scour and/or erosion damages. However, this is subject to approval and the associated requirements for the Town, the District, U.S. Army Corps of Engineers, and FEMA. Such activities may require a study to be completed for the applicable agencies. In order to determine what may be required for a particular location, contact the Town Engineer.

**A.R.S. 48-3615. Violation; classification; civil penalties; strict liability**

**A. It is unlawful for a person to engage in any development or to divert, retard or obstruct the flow of waters in a watercourse if it creates a hazard to life or property without securing the written authorization required by section 48-3613. Where the watercourse is a delineated floodplain it is unlawful to engage in any development affecting the flow of waters without securing written authorization required by section 48-3613.**

## **AESTHETIC GUIDELINES**

Drainage and stormwater storage facilities should present an aesthetically pleasing appearance that replicates the natural desert landscape as closely as possible. This can be accomplished by contouring the bottoms and sides of basins to enhance appearance through varied and naturally appearing slopes. The use of native plants and boulders is also encouraged to achieve a restored natural environment. Boulders used for hillside restoration can be treated with a surface stain for aesthetic color matching if approved by the Town Engineer. When re-establishing disturbed areas, plant densities and varieties should mirror the surrounding, undisturbed areas. Where long stretches of a wash along several properties require stabilization, treatments should be uniform.

## **MAINTENANCE**

All public and private drainage control, flood control, stormwater storage, and erosion control facilities shall be maintained to ensure they function properly to reduce the potential for damage of upstream or downstream facilities. Drainage control features shall be maintained according to the general standards presented in the *Grading and Drainage Design Guidelines for the Town of Cave Creek*.



**100-Year (or Base) Flood.** A flood event that statistically has a 1 out of 100 (or one percent) chance of being equaled or exceeded on a specific watercourse in any given year. A flood event of this magnitude is often used to determine if flood insurance is either advisable or required on a property.

**Acre-foot.** The volume of water necessary to cover an acre of land to a depth of one foot. It equals 43,560 cubic feet or 325,851 gallons.

**Base Flood Elevation.** A base flood elevation (BFE) is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929, the North American Vertical Datum of 1988, or other datum referenced in the Flood Insurance Study report, or the depth of the base flood, usually in feet, above the ground surface.

**CFS.** The measuring unit of cubic feet per second (cfs), which is used to quantify the amount of flow in a wash. A cubic foot is equivalent to 7.5 gallons of water. Thus, 1 cfs is 7.5 gallons of water passing by you every second.

**Channel.** An open conveyance of surface stormwater having a bottom and sides in a linear configuration. Channels can be natural or man-made. Channels may have levees or dikes along their sides to build up their depth. Constructed channels can be plain earth, landscaped, or lined with concrete, stone, or any other hard surface to resist erosion and scour.

**Culvert.** A hydraulically short conduit which conveys surface water runoff through a roadway embankment or through some other type of flow obstruction.

**Delineation.** Defining the physical boundaries of a stream, floodplain, jurisdictional wash, etc.

**Deposit.** Something dropped or left behind by moving water, as sand or mud.

**Detention Basin.** A basin or reservoir where water is stored for regulating a flood. It has outlets for releasing the flows during the floods

**Development.** A man-made change to property, such as buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations.

**Discharge.** The amount of water that passes a specific point on a watercourse over a given period of time. Rates of discharge are usually measured in cubic feet per second (cfs).

**Dry Well.** A deep hole, covered and designed to hold drainage water until it seeps into the ground.

**Elevation.** A water-level expressed in terms of mean sea level. It differs from stage, which is a water-level in terms of some local datum.

**Elevation Certificate.** The Elevation Certificate is an important administrative tool of the National Flood Insurance Program (NFIP). It is to be used to provide elevation information necessary to ensure compliance with community floodplain management ordinances, to determine the proper insurance premium rate, and to support a request for a Letter of Map Amendment or Revision (LOMA or LOMR-F). Go to [www.fema.gov/business/nfip/elvinst.shtm](http://www.fema.gov/business/nfip/elvinst.shtm) to download the Elevation Certificate Instruction or from FEMA.

**Encroachment.** The result of placing a building, fence, berm or other structure in a floodplain in a manner that obstructs or increases the depth (or velocity) of flow on a watercourse.

**Erosion.** The wearing away of land by the flow of water.

**FCDMC.** Acronym for Flood Control District of Maricopa County.

**FEMA (Federal Emergency Management Agency).**

An independent federal agency established to respond to major emergencies that state and local agencies don't have the resources to handle. FEMA seeks to reduce the loss of life and protect property against all types of hazards through a comprehensive, risk-based emergency management program. Visit the FEMA web site at [www.fema.gov](http://www.fema.gov).

**FIRM.** Acronym for Flood Insurance Rate Map.

**Flood Insurance Rate Map (FIRM).** Issued by FEMA, these maps show special hazard areas, including the 100-year floodplain. They also show flood insurance risk zones and other flood-related information applicable to a community.

**Flood Insurance Study (FIS).** Hydrologic and Hydraulic studies that identify a flood hazard area, flood insurance risk zones and other flood data such as flood depths and velocities.

**Flood/Flooding.** A temporary condition caused by the accumulation of runoff from any source, which exceeds the capacity of a natural or man-made drainage system and results in inundation of normally dry land areas.

**Floodplain.** The area adjoining a watercourse that may be covered by floodwater during a flood.

**Grading.** Disturbance of existing land contours.

**Hydraulics.** A field of study dealing with the flow pattern and rate of water movement based on the principles of fluid mechanics.

**Hydrology.** A field of study concerned with the distribution and circulation of surface water, as well as water dynamics below the ground and in the atmosphere.

**LOMA (Letter of Map Amendment).** An official amendment of a current Flood Insurance Rate Map (FIRM) accepted by FEMA for a property or a structure. The LOMA verifies that the structure or portions of the property have been removed from a designated-floodplain area.

**LOMR (Letter of Map Revision).** An official revision of a current Flood Insurance Rate Map (FIRM) accepted by FEMA, which reflects changes in mapped areas for flood zones, floodplain areas, floodways and flood elevations.

**Major Wash.** Any watercourse with an officially delineated Flood Hazard Zone or any wash having a drainage basin of ten (10) acres or larger.

**Minor Wash.** Any watercourse having a drainage basin of less than ten (10) acres.

**National Flood Insurance Program (NFIP).** A federal program that allows property owners to purchase insurance protection against losses due to flooding. In order to participate in this program, local communities must agree to implement and enforce measures that reduce future flood risks in special flood hazard areas. Go to [www.fema.gov/nfip](http://www.fema.gov/nfip) for additional information.

**Precipitation.** All forms of water that fall to the earth's surface - including rain, snow, sleet and hail.

**Regulatory.** Subject to the control of or required to follow rules set forth by a governmental agency. With respect to washes or streams it refers to those areas where the federal government restricts the use or development of areas it has deemed to be "Waters of the U.S." These regulations are part of the Clean Water Act.

**Regulatory Flood Elevation.** The elevation which is one foot above the base flood elevation for a watercourse. Where a floodway has been delineated, the base flood

elevation is the higher of either the natural or encroached water surface elevation of the 100-year flow.

**Regulatory Floodplain.** A portion of the geologic floodplain that may be inundated by the base flood where the peak discharge is 100 cubic feet per second (cfs) or greater. Regulatory floodplains also include areas which are subject to sheet flooding, or areas on existing recorded subdivision plats mapped as being floodprone.

**Retention Basin.** A basin or reservoir where water is stored for regulating a flood. Unlike a detention basin, it does not have outlets for releasing the flows, the water must be disposed by draining into the soil, evaporation, or pumping systems.

**Runoff.** The portion of precipitation on land that ultimately reaches streams, especially water from rain or melted snow that flows over ground surface.

**Sediment.** Soil particles, sand, and minerals washed from the land into aquatic systems as a result of natural and human activities.

**Sedimentation.** A large-scale process where sediment is transported by water and deposited downstream.

**Setback.** The minimum distance required between a man-made structure and a watercourse. This distance is measured from the top edge of the highest channel bank or the edge of the 100-year flood water surface elevation.

**Soil Erosion.** The processes by which soil is removed from one place by forces such as wind, water, waves, glaciers, and construction activity and eventually deposited at some new place.

**Special Flood Hazard Areas (SFHA).** FEMA designates certain types of zones as Special Flood Hazard Areas (SFHA). These are the zones that start with an "A" and, roughly speaking, correspond to the limits of the 100-year

flood for that area. Although the 100-year boundary was chosen as the SFHA limit, property located just outside this boundary is almost equally at risk as one just inside it.

**Spillway.** An outlet pipe or channel serving to discharge water from a dam, ditch, gutter, or basin.

**Storage.** The volume of water stored in a basin or behind a dam – usually expressed in acre-feet. It differs from capacity, which is the volume of water stored at the emergency spillway elevation.

**Stormwater.** Precipitation from rain or snow that accumulates in a natural or man-made watercourse or conveyance system.

**Surface Water.** Water that flows in streams, rivers, natural lakes, wetlands, and man-made reservoirs.

**Watercourse.** Any minor or major lake, river, creek, stream, wash, arroyo, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur.

**Waters of the U.S.** All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce.

**Watershed.** An area from which water drains into a lake, stream or other body of water. A watershed is also often referred to as a basin, with the basin boundary defined by a high ridge or divide, and with a wash, river or lake located at a lower point.





## **CONTACT**

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