



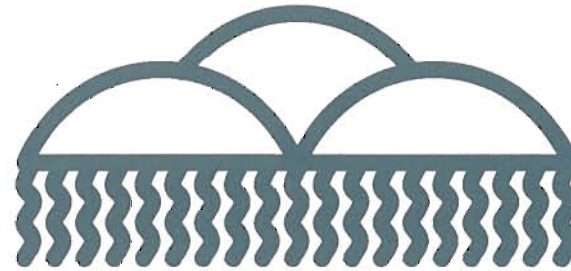
**AMAFCA**

Albuquerque Metropolitan Arroyo Flood Control Authority

## On the cover:

The photograph of a baffle chute on AMAFCA's South Diversion Channel tells a dramatic story about the potential force of flood waters. In this case, the energy of the water, flowing at around one million gallons per minute, is dissipated as it descends a thirty foot drop to lower terrain.

The same baffle chute, the way it looks most of the time, is shown below. Though its primary purpose is to slow the flow of water, it is also architecturally pleasing.



## Table of Contents

Floods in the Desert.....	4
Albuquerque Can Flood in Two Ways.....	4
Why Do We Have Floods From Arroyos? .....	4
Respect the Power of Water .....	6
What You Can Do To Protect Your Property.....	7
Help Minimize Flooding Dangers for All of Albuquerque.....	7
What's a Hundred-Year Storm?.....	8
Who Deals with Flood Control on a Local Level? .....	8
Do Other Groups Help with Flood Control? .....	8
What is AMAFCA?.....	9
What Does AMAFCA Do?.....	9
How Does AMAFCA Do It?.....	9
How is AMAFCA Funded?.....	9
What Your Tax Dollars Have Done So Far.....	10
AMAFCA Projects Protect Albuquerque .....	10
AMAFCA Projects Are Also Built with People in Mind.....	10
AMAFCA Does Other Work, Too.....	13
AMAFCA Is an Important Part of Albuquerque .....	14



## Floods in the Desert

Albuquerque experiences dangerous flooding conditions somewhere in the city about a dozen times per year. Albuquerque floods can be particularly hazardous because the origin of the flood may not be obvious at the floodsite itself. Distant thunderstorms in the Sandia Mountains, as well as storms in just one part of the city, can result in an unexpected wall of water which roars through arroyos and channels. Many people are unaware of the hazards; consequently, nearly every year Albuquerqueans experience personal injuries and property damage from floods. Helping people prevent these injuries and damages is the mission of the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA).

## Albuquerque Can Flood in Two Ways

Flooding in Albuquerque may occur in two ways: flooding caused by the overflow of the Rio Grande, and flash flooding which comes through arroyos and drainage ditches.

Flooding from the Rio Grande principally affects the Valley, but is a rare occurrence



*Sediment plug in the Rio Grande carried by rain in the Calabacillas Arroyo, August, 1988*

because of upstream dams and riverside levees. Large flows in the Rio Grande, however, coupled with sediment plugs from flooding arroyos which drain into the river, can cause the water to overtop the levees.

The other type of flooding - flooding from arroyos - is much more frequent and can occur somewhere in Albuquerque several times a year.

Area rainstorms are typically of high density and short duration, and they are localized. This type of storm produces flash flooding.

A typical rainstorm can drop an inch of water in less than one hour. This one inch of rain falling on the steep slopes of the city results in raging torrents of water that rip through arroyos and surge over the banks, sweeping everything before them. Prediction times - and thus warning times - are minimal.

And flash flooding can affect the whole

community, or only portions of it. Safe conditions in one part of the city do not guarantee safe conditions in another area.

There are approximately a dozen rainstorms like this every year. They mostly occur from June through September. The most severe storms occur in late summer when moist air moves north from the Gulf of Mexico. When this moist air encounters rising heat from the city and meets the slopes of the mountains, huge thunderheads can develop in minutes.



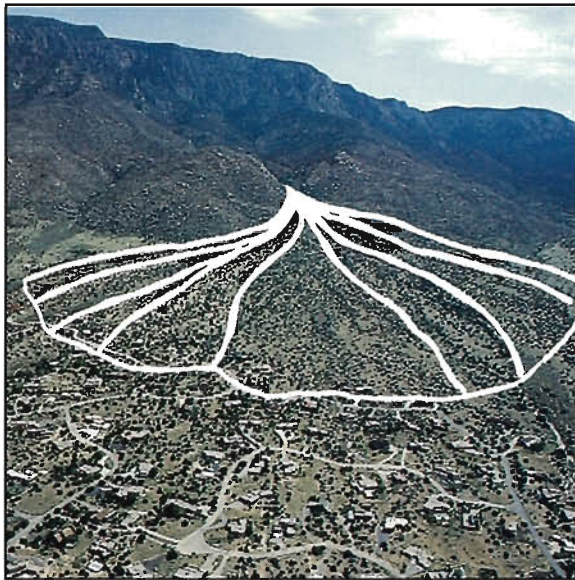
*East side arroyo during rainstorm.*

## Why Do We Have Floods From Arroyos?

Much of Albuquerque is built on alluvial fans in the Sandia Mountains. Alluvial fans are large fan-shaped sediment deposits at the base of the mountains.

As rain falls, it flows down the steep, sandy slopes, picking up sediment and debris.





*Housing built on alluvial fans. Overlaid lines on photograph show alluvial formations.*

The fast-moving, muddy water can change the course of arroyos quickly, cutting new channels, filling old ones with sediment, and overwhelming bridges and culverts. Often the sediment that travels with the water is as big a problem as the water itself.

The path that stormwater is predicted to take is often plotted on a map, and the area which would be covered with water is shown as a floodplain. Houses built in or near a floodplain can be inundated in minutes, causing heavy damage.

Even when an area has storm drains, they sometimes are overwhelmed by the intense storms. Localized flooding is the result.



*Truck smashed by boulders, Juan Tabo and Indian School, July 9, 1988*



*House and car damaged by floodwater and sediment, July, 1991*

Some flooding occurs naturally; however the danger is enhanced by changing the high desert from its natural state to an inhabited

environment. Development of any kind radically alters the rainfall-to-runoff relationship. Covering the desert with roofs and pavement, which do not absorb water, dramatically increases the amount of stormwater runoff.

Homes, businesses, walks, fences and roads built in or near arroyos block or change the natural flow of water, sometimes causing problems on adjacent or downstream properties.



*An urbanized arroyo*





*North Pino Arroyo and backyards, following 1980 storms.*

In some areas of Albuquerque, vast acreages were subdivided with no consideration for drainage. Lots were sold to buyers from around the world. Years later, landowners who want to build homes find that drainage is a major obstacle to development.



*Aerial view of North Albuquerque Acres*

In other areas, homes and subdivisions were built before adequate drainage regulations were in place. Lack of respect for the arroyos, indiscriminate grading of roads, and undersized culverts have made these areas vulnerable to flooding. These conditions exist mostly in the Valley and in older subdivisions.

### Respect the Power of Water

In general, *stay out of arroyos and channels*, even if they are dry. Even if it is not raining where you are, there may be storms miles up the arroyo which can turn it into a raging torrent. Remember these guidelines:

1. Stay out of arroyos and channels in which there is any water at all.

Water six inches deep running at five miles per hour (about as fast as you can run) will exert a force of 50 pounds on your legs. This force, combined with a slippery bottom, can sweep you off your feet. Once you are caught in such a current, it will be very difficult to get out.

2. Don't drive across flooded arroyos, even if you have a four-wheel drive vehicle.

Water flowing one foot deep at ten miles per hour can exert a sideways force of one ton

on your vehicle. This force, combined with your vehicle's buoyancy, can easily cause it to float away.



*Victim in a concrete channel who, fortunately, was rescued. (From news film footage)*



*A baby being rescued from a car swept away in a 1982 storm. (From news film footage)*

3. Don't attempt to drive through flooded areas. The road could be washed away underneath the water. Your car could be trapped and damaged.

4. During flash flood season, watch your television or listen to your radio for flash flood warnings and reports of flooding in progress. Be prepared to move out of harm's way at a moment's notice. If you are driving, watch for flooding at bridges, dips and low areas. Watch for signs of distant rainfall, such as thunder or lightning.

5. Use common sense, and above all, *respect the power of water.*

## What You Can Do to Protect Your Property

If you have a choice, stay out of flood-prone areas. Before you buy any property, find out if it is in a floodplain or in a high flood hazard area.

You can find out if the property is located in a floodplain by submitting a written request for information along with a legal description (Lot No., Block No., and subdivision name) and if possible, the address, to:

**The City/County Floodplain  
Administrator  
City of Albuquerque  
P.O. Box 1293  
Albuquerque, NM 87103**

There is a small fee for this service. The Floodplain Administrator also has copies of floodplain maps available for public viewing.

If you own property and plan to build on it, check with the City/County Floodplain Administrator or with AMAFCA to find out if your property is in a floodplain. Even if the property is not located in a floodplain, you may be required to have a grading and drainage report done by a registered professional engineer and approved by the City, County, or AMAFCA. Things you should do to protect your property include:

1. Find out whether you need to carry flood insurance on your property. Your mortgage lender should be able to tell you, or you can check with the City, County, or AMAFCA.

2. Check the drainage around your house or building to ensure that water flows away. Don't fill in ponding areas on your property.

3. Be careful about changing the contour of the land without checking on the drainage.

Altering your property to change the flows of water may be a violation of the law.

4. Be sure drainage facilities and easements are kept free of debris and silt so stormwater will not flood you or a neighbor.

## Help Minimize Flooding Dangers for All of Albuquerque

Don't dump trash, debris, or tree limbs in arroyos or channels. They can plug drainage structures and cause flooding.



*Careless dumping can cause problems.*

If you see drainage structures plugged with debris, please call one of the following numbers so crews can be dispatched to clear out the problem:

Inside the city limits: **291-6214**

Outside the city: **884-2215**

Should flooding occur, the City of Albuquerque may have some sandbags available. Call **857-8025** for information. In an emergency, plastic bags can be used, but they should not be overloaded. AMAFCA does not have sandbags for public distribution.

If you do live in a low-lying area, learn evacuation routes that avoid bridges, dip crossings, and low-level roadways. Careful preparation and prompt response will help ensure your personal safety.

## What's a Hundred-Year Storm?

The hundred-year storm is better defined as a storm that has a one percent chance of occurring in any given year. Over a 10-year period, there is almost a 10% chance of such a storm. Over a 30-year period (the length of a typical home mortgage), there is a 26% chance of such a storm.

In Albuquerque, the specific definition of such a storm depends upon the location within the city. On the West Mesa, a hundred-year storm is defined as 2.2 inches of rain falling within six hours. Near the Sandias, the hundred-year storm consists of 2.9 inches falling within six hours. In both cases, about two inches of the storm can be expected to fall in the peak hour; over one inch can be anticipated in the peak 15 minutes alone.

Albuquerque may experience several hundred-year storms each summer. These storms are usually localized and may only cover one square mile or so, although the runoff water can cause major problems elsewhere.

Almost all major flood control structures are designed for the hundred-year storm. That means that channels are built to carry the hundred-year flow, and dams are built to contain the hundred-year storm water volume. And floodplain maps are based on the hundred-year flow.

Many storm sewers and road culverts, particularly in older areas, were only built for the runoff from smaller storms. This means that some areas will experience flooding more often than others.

## Who Deals with Flood Control on a Local Level?

The management of such a large problem involves several agencies. While there is more than one group, each agency has specific responsibilities, cooperates with other agencies to eliminate duplication of services, and can either offer helpful information or refer a citizen to the appropriate group.

AMAFCA, builds, operates and maintains most dams and most of the larger channels on the East and West Mesas; the so-called "main stem" of the flood control system.

The City of Albuquerque owns most of the smaller channels, the storm drains, and a few dams. Almost all of these drainage structures flow into AMAFCA facilities.

Bernalillo County maintains most of the culverts, roadside ditches, and some of the storm drains outside the city limits.

The New Mexico State Highway and Transportation Department owns the channel in the median of I-40, plus bridges and culverts on the Interstate and State highways.

The Middle Rio Grande Conservancy District owns almost all the canals and drains in the valley. It also maintains the levees along the Rio Grande.

## Do Other Groups Help Out?

Federal agencies are also involved in the program. The Army Corps of Engineers built the first major flood control projects, and remains a major presence in flood protection for Albuquerque.

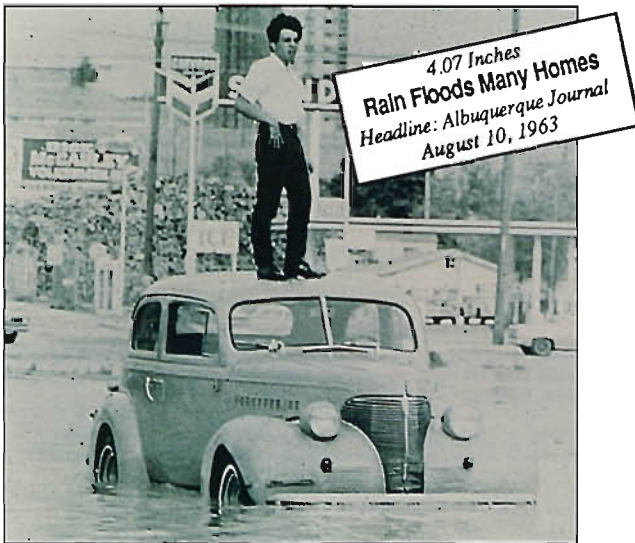
Other Federal agencies, including the Bureau of Reclamation, the Soil Conservation Service and the Forest Service also have roles in flood and soil erosion control measures.

All agencies involved in flood control maintain close and continual coordination and cooperation to ensure effectiveness. Since storm waters do not recognize any boundaries, coordination also takes place with Kirtland Air Force Base, the Pueblos of Sandia and Isleta, and Sandoval County agencies and communities.



## What Is AMAFCA?

The Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA) was created in 1963 by the New Mexico Legislature with specific responsibility for flooding problems in greater Albuquerque.



1963 flooding in Albuquerque

## What Does AMAFCA Do?

AMAFCA's purpose is to prevent injury or loss of life, and to eliminate or minimize property damage. AMAFCA does this by building and maintaining flood control structures which help alleviate the problem.

## How Does AMAFCA Do It?

The first mission of AMAFCA was to be the local sponsor for construction of two very large federally-funded projects, the North and South Diversion Channels, which were built by the Army Corps of Engineers. AMAFCA today is still responsible for those two main flood control structures. Additionally, AMAFCA plans, builds, operates and maintains flood control facilities throughout the greater Albuquerque area. AMAFCA also establishes drainage policy and regulates development within its defined boundaries, which extend beyond the City limits, but do not cover all of Bernalillo County.



AMAFCA Board of Directors meets monthly.

AMAFCA is a political subdivision of the State of New Mexico, and is governed by a publicly-elected five-member Board of Directors. Directors are elected at large during the general election, and serve six year staggered terms.

The Board, which meets monthly, sets policy, establishes the overall priorities for flood control projects, adopts resolutions (ordinances), approves the budget, and sets the mill levy. The mill levy is that portion of property taxes which supports AMAFCA's flood control mission.

The AMAFCA permanent staff is quite small - about 15 people - of which nine are on the maintenance crew.

To remain small and efficient, 90% of AMAFCA's budget is contracted out. Tasks such

as engineering, construction, major maintenance, legal work, real estate appraisals, surveying, audits, equipment repair, janitorial, and other services are all awarded to local contractors who meet AMAFCA standards.

## How is AMAFCA Funded?

AMAFCA's sole source of revenue is the ad valorem (property) tax. Only about three to four percent of the total property tax goes to AMAFCA. This



means that the owner of a \$90,000 home pays about \$25 a year to AMAFCA.

The annual operating budget of about \$1.2 million pays for everyday operations. Roughly half goes directly toward maintenance of flood control facilities. The remainder funds staff salaries, engineering and planning, and a contingency (emergency) fund.

The debt retirement budget pays principal and interest on bonds which are used to finance the construction program. This program averages about \$5 million per year.

Bond elections are held periodically; typically every four to six years. Voters always have the right to approve AMAFCA's construction program.

### What Your Tax Dollars Have Done So Far

Through your taxes, about \$80 million has been invested in AMAFCA's flood control program for the community. AMAFCA has built 30 dams, over 50 miles of channels, and six miles of underground culverts - some big enough to drive a car through.

### AMAFCA Projects Protect Albuquerque

One of the ways in which AMAFCA fulfills its mission is by building dams and channels.



*Typical AMAFCA flood control channel*



*Typical AMAFCA dam*

Traditional flood control measures focus on protection of existing developments through construction of dams (to hold water back) and channels, which divert or confine flows.

A typical AMAFCA dam contains a principal spillway, which is a pipe under the dam, and an emergency spillway, which is the large channel around the side or over the top of the dam. Dams and other types of detention basins collect floodwater, and release it slowly to prevent downstream damage. AMAFCA dams are capable of fully detaining the one percent (hundred-year) storm. A storm greater than that, however, could flow through the emergency spillway, which is a safety valve, and cause some downstream flooding.

State regulations require that stormwater be released to the river within 96 hours after a storm. Consequently, all AMAFCA dams are dry and may not look like dams at all.

### AMAFCA Projects Are Also Built with People In Mind

Because the AMAFCA dams only hold water once in a great while, they can make good sites for other uses. AMAFCA works closely with both City and County Parks and Recreation Departments, and others, in making land available for recreation and other uses.

For example, Ladera Golf Course is actually Ladera Dam Number 15. Because the dam rarely holds stormwater, it was made available to become a popular City golf course. Ladera Dams 1 through 14 are above the Golf Course, and protect Interstate 40 and other areas from flooding.



*Aerial picture of Ladera golf course with other dams in upper left quarter of photograph.*

And the emergency spillway area of the North Domingo Baca Dam has become prime Little League Baseball territory, sporting several diamonds.

Nearby, a County Fire Station is built on AMAFCA property next to AMAFCA's South Domingo Baca Dam. And through a cooperative agreement with the City Open Space Division, the Albuquerque Conservation Trust, and a neighborhood association, the reservoir area behind John Robert Dam has been preserved as Open Space and floodplain.

While dams hold the water back, channels are an efficient means of moving floodwater to the river.

Natural arroyos are the original channels of Albuquerque. Unfortunately, in many cases, the natural flow path to the river has been blocked by sediment deposition, or human activities such as the construction of homes, roads, railroads, canals, ditches, and riverside levees. Even when the original arroyo has been preserved, so to speak, the development of land adjacent to an arroyo forever changes the nature of



*Open space is a welcome refuge in the midst of urbanization. John Robert Dam is in the foreground.*



*Bike trail along the North Diversion Channel*

flows in the arroyo, often to the point where the only solution is a concrete lining.

Arroyos, and their urbanized counterpart, channels, also provide opportunities for recreation and as connecting corridors for parks and open space.

In recognition of this, a plan has been developed to preserve some arroyos in a naturalistic condition, and to use other arroyos or channels as corridors for utilities, hikers, bicyclists, and horse trails.

Where conditions allow, channels have been lined with native rock or other erosion-resistant material, and reseeded with native grasses. These measures help them blend back into the landscape.





*Borrega Diversion Channel, rock and grass lined*

is more natural-looking than a concrete-lined channel.



*Calabacillas Arroyo soil-cement bank looks more natural than concrete*

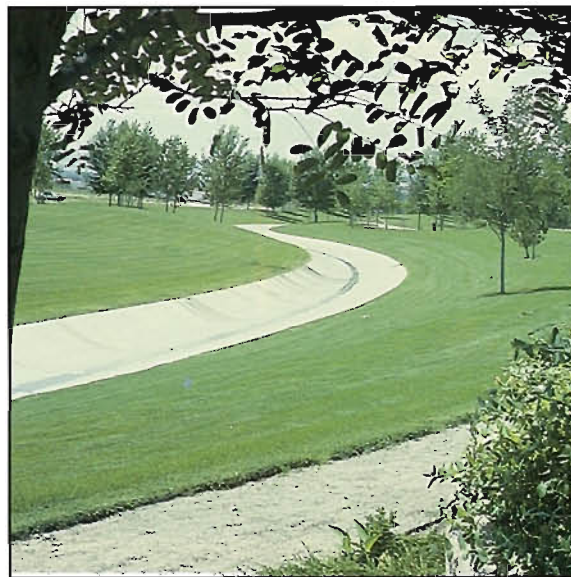
AMAFCA has built also channels in park sections, where a neat, park-like appearance is a plus.

To conserve costs, AMAFCA and the Middle Rio Grande Conservancy District have cooperated to allow the use of irrigation facilities to carry stormwater. These channels carry irrigation water eight months of every year, but are also capable of carrying the runoff from a hundred-year storm.



*San Antonio Channel used a man-made mat to prevent erosion and to promote vegetation. Two years after construction, there is lush growth.*

Where erosion control is essential, AMAFCA has built channels which have soil-cement bank protection. Soil-cement is made by mixing cement and water with native soil, and spreading and compacting it with heavy equipment. This produces a protected channel which



*North Pino Arroyo Channel in the Journal Center.*



*Cabezon Channel, a combination flood control and irrigation channel, in a park section.*

Underground pipes carry stormwater, too, and Albuquerque is laced with an extensive system of storm sewers and large pipes and culverts. AMAFCA maintains about six miles of stormwater pipes.



*La Orilla Channel is a combination channel built with sprayed-on concrete to preserve trees and to protect a nearby archeological site.*

## AMAFCA Does Other Work, Too

Another manner in which AMAFCA fulfills its mission to protect lives and property is in managing floodplains and in enforcing regulations.

Enforcing drainage regulations is a controversial but necessary AMAFCA function. The regulations are written to protect natural water courses and to prevent landowners and their neighbors from being flooded.

Having floodplain management regulations is a requirement of the National Flood Insurance Program, the agency which guarantees that people who live in a floodplain can buy flood insurance. The floodplains are defined by maps produced by the Federal Emergency Management Agency.



*Geneva Meeker, AMAFCA Board member, examines a floodplain map*

Managing floodplains means determining what uses can safely occur in a floodplain (such as farming, open space, or certain types of recreation), and what types of development can occur in or near the floodplain.

Developers and builders must submit their drainage plans, which are reviewed to be sure the water flow is not increased and that the development does not cause damage to its own or neighboring properties.

Even with proper drainage plans, there may be accumulations of water in streets. Stormwater in streets may be a nuisance and it may slow traffic, but it isn't usually a flood. In this part of the country, with our low annual

rainfall scattered throughout the year, it just isn't economically feasible to design a system to control all stormwater. Albuquerque streets, therefore, are frequently designed to carry stormwater away from houses and businesses.

AMAFCA also performs maintenance and emergency operations.



*The maintenance crew of nine people works full time to take care of AMAFCA's 30 dams, 50 miles of channels, six miles of underground pipe, dikes, and associated roads, fencing, gates, and signs.*

In addition to routine maintenance, AMAFCA closely monitors all its facilities during the heavy rain season, and when damage occurs, the response is rapid.

AMAFCA cooperates with the U.S. Geological Survey in a program to measure rainfall, runoff, and stormwater pollutants. And



in conjunction with the National Weather Service, AMAFCA sponsors a volunteer rainfall reporting system. Over 100 volunteers scattered throughout the Albuquerque area measure and report rainfall, which allows more accurate prediction and planning for flood control and drainage. If you are interested in being an active volunteer, please contact AMAFCA.

AMAFCA also sponsored and supports a hydraulic laboratory at the University of New Mexico, where experiments can be run to provide more efficient designs and to find better ways to deal with stormwater.

## AMAFCA Is an Important Part of Albuquerque

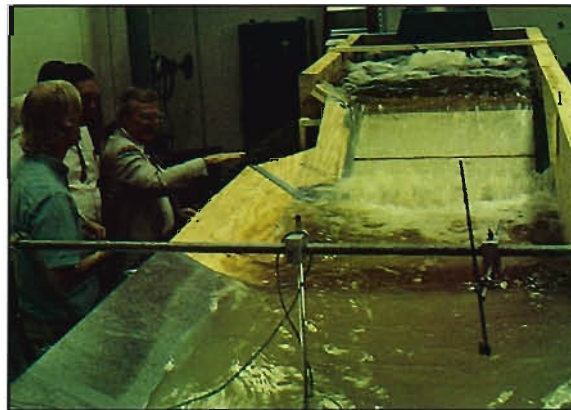
Since its establishment in 1963, AMAFCA has taken seriously its mission of providing flood control for the community.

Although some \$80 million has been invested in flood control over these years, the job is not done. Continued community growth, tougher regulations, higher expectations and new opportunities (such as the Petroglyph National Monument) present fresh challenges in managing stormwater.

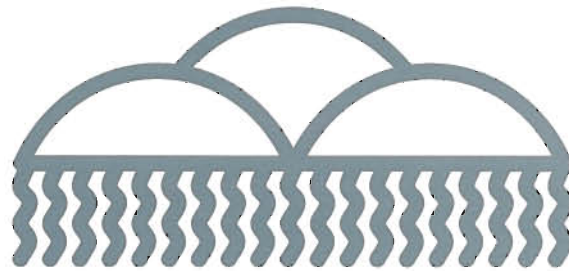
The AMAFCA Board of Directors solicits your ideas on the many drainage-related issues facing the community.



*Sediment removal is a big job, averaging 80,000 cubic yards every year.*



*Graduate students and engineers study a spillway design at UNM*



# **AMAFCA**

Albuquerque Metropolitan Arroyo Flood Control Authority

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