MEMORANDUM

Date: August 7, 2020

To: The Honorable Chairman and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **Pima County Regional Flood Control District History Booklet**

The enclosed booklet, *History of the Pima County Regional Flood Control District* celebrates and highlights over 40 years of floodplain management within unincorporated Pima County and surrounding jurisdictions. The booklet describes various voter-supported infrastructure improvements, District ecosystem and riparian restoration efforts and the benefits of acquiring floodprone property.

You may also view the booklet online at:

https://webcms.pima.gov/UserFiles/Servers/Server_6/File/Government/Flood%20Control/Public%20Outreach/handout-flood-control-history-book.pdf

The goal of the Regional Flood Control District is to protect Pima County residents' lives and their property and through District efforts, this objective is in full effect throughout the year– – before, during and after every monsoon season.

I am proud to share the District's story with you and to acknowledge the numerous contributions from the men and women of the District whose dedicated service helps to protect all Pima County and Southern Arizona residents.

CHH/lab

Attachment

c: Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Yves Khawam, Assistant County Administrator for Public Works
Suzanne Shields, Director, Regional Flood Control District

History of the Pima County Regional Flood Control District

PIMA COUNTY
FLOOD CONTROL

"We're dealing with people's lives, their livelihoods and their homes and businesses. Failure is not an option."

District Director and Chief Engineer Suzanne Shields, 2020

Planning, foresight is why Flood Control has worked

You don't hear much about the Regional Flood Control District. If you did, it would be bad. Flood Control is one of the government programs that rarely make the news except when something goes wrong. For 40 years, not much has gone wrong in the District. When it rains, the water goes where we want it to go – into the major waterways of the county where it is controlled and funneled safely through town, protecting lives and property.

Chuck Huckelberry

The system works as it was designed. The majority of the credit for that incomparable record of performance and public safety goes to the dedicated staff and the many contractors and engineers who have worked over the years to build our flood control infrastructure from which we all benefit.

But credit must also be given to you, the taxpayers of Pima County, who have funded the public works projects of the District for 40 years through and annual property tax and four separate bond elections.

Chuck Huckelberry (left) and staff participate in a groundbreaking ceremony for the construction of the Abrego box culvert; July 1984

You have contributed nearly $400 million over the years which District staff has used to build the flood infrastructure that keeps you safe.

This booklet commemorates the District's more than 40-year history, how it came to be, its major projects and programs, and how it works to protect the people of Pima County and their homes and businesses.

None of it would have been possible without you and your willingness to fund that which is hard to see and rarely noticed because it works so well.

On behalf of all of the staff of Pima County and the Regional Flood Control District – thank you.

Chuck Huckelberry,
Pima County Administrator

District has had successes, but the work continues

It is my great privilege to serve as Director and Chief Engineer of the Pima County Regional Flood Control District. I lead an organization made up of dedicated professionals who seek to provide the highest quality flood protection and floodplain management services for our community while emphasizing fiscal responsibility and the protection of natural resources.

Suzanne Shields

Since 1978, the District has installed more than 100 miles of bank protection and other infrastructure in Pima County and removed thousands of acres and tens of millions of dollars of property from federal and local floodplains. Our efforts also have enhanced property values, restored riparian areas, improved groundwater recharge rates and provided the foundation for tremendous public amenities such as the Kino Environmental Restoration Project, The Chuck Huckelberry Loop and numerous parks and other facilities.

I am grateful for the support and cooperation the District receives from County Administration and other departments as well as the state, tribal and federal agencies and various municipalities and professional organizations we partner with to complete our work. I also want to include a special "thank you" to the District's remarkably talented and meticulous staff, both past and present, whose steadfast commitment to excellence has made the District one of the premiere flood control agencies in the nation.

Flood Control Director and Chief Engineer, Suzanne Shields (third from right), participates in a groundbreaking ceremony for the Pantano Wash Bank Protection-Phase 3; August 2015

Our job will never be done. There will always be more that we can do to improve our infrastructure and our programs to ensure the safety and welfare of the residents of Pima County and the thousands of visitors to the region.

I hope this book will provide readers with a sense of the District's mission, the scope of its projects and the benefits of its programs.

Suzanne Shields, P.E.
Director and Chief Engineer

A duty to protect lives and property

It started to rain shortly after midnight on September 30, 1983. It kept raining for three days. The rain from a stalled tropical storm fell on ground already saturated from a late September surge in monsoon thunderstorms. The deluge filled to the brim the rivers and washes of the Tucson valley, home to over 800,000 people at the time. And then the rivers overflowed.

When it was over, it was known as the worst flood in Pima County's recorded history - nine people killed, hundreds injured, bridges and roads washed away, hundreds of millions of dollars in property lost or damaged. The state of Arizona just five years before had required all counties to create Flood Control Districts to raise a property tax to fund flood control infrastructure. The Pima County Regional Flood Control District (District) had just barely begun implementing its strategic plans crafted over the first few years of the District's existence when the great flood hit. Some of the assumptions that had been made before 1983 about the behavior of floodwaters during flood events had to be tossed out; new plans were needed. While devastating and tragic, the Great Flood of '83 was a graduate course on flood control. Over the next three decades, the leaders and staff of the District took those painful lessons and created one of the best flood management programs in the country. To prevent or alleviate flash flood rampages, the District learned to slow the water down, redirect it into detention basins, keep the wash and river levels low, and contain the flow in bank-protected channels.

Since 1983 there have been at least four major flood events in which nearly as much water as the '83 flood filled the rivers and streams. The water stayed where the District intended it to stay. No lives were lost, no bridges washed out and property damage was minimal. Flood control works.

This booklet is a brief history of the District's 40 years of existence* and a tribute to the men and women of the District who have dedicated their careers to protecting the people of Pima County from the devastating effects of flooding.

*The vast majority of the District's flood control projects have been in the eastern part of the county where 99 percent of the population lives. The enormous area west of metro Tucson, roughly the size of Vermont, is mostly uninhabited and has fewer than 30,000 people.

Left: The October 1983 flood was the largest flood of record in the Tucson area. Damage to public infrastructure was estimated at $64 million, with total damage exceeding $105 million, and four people died in flood related incidents.

A history of flooding

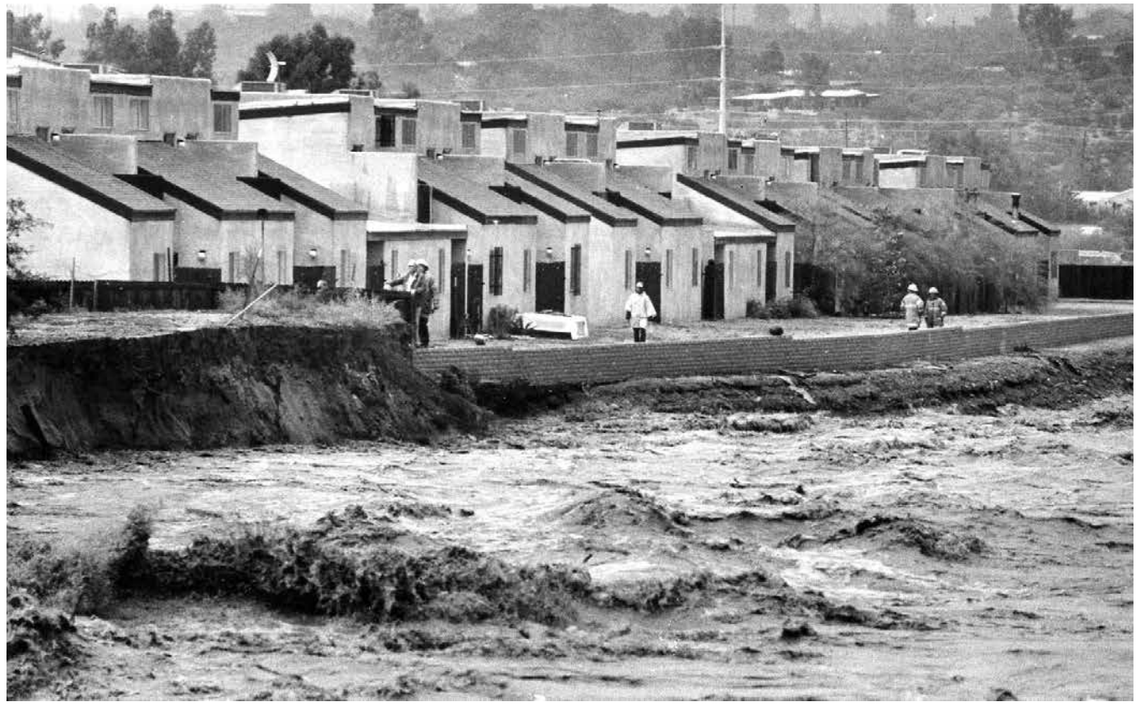
The primary problem of living in a desert is the lack of water. Sometimes, though, there's too much water and that can be far more dangerous as bone-dry washes turn into raging torrents in just a few minutes. The geology and geography of eastern Pima County, where 99 percent of the people live, make it prone to frequent flash floods. And unlike other deserts of the Southwest that have only one rainy season per year, the Sonoran Desert has two – soaking winter cold fronts that roll in off the Pacific coast, and the summer Monsoon which brings with it powerful afternoon thunderstorms. And then there's the occasional depleted hurricanes that form off Baja California and instead of heading west across the Pacific, make a fishhook turn and head back across the Baja and the Gulf of California, pouring across Arizona as tropical storms or depressions, sometimes dropping as much rain in a couple of days as a full three-months of summer monsoon storms.

Geographically, metropolitan Tucson sits in a giant bowl. It's a valley surrounded by tall, steep mountains that can stall or slow storms and precipitate out moisture, creating runoff that flows down the mountains in a web of streams crisscrossing the valley floor. In the summer, moisture-laden air flowing up from the Gulf of Mexico hits the hot air rising up the sides of the mountains creating giant thunderheads that burst open to release millions of gallons of water, with some cloudbursts concentrated in just a few square miles. The deluges drop fast and hard. Desert soils can't absorb all that water and it runs rapidly across watersheds, filling arroyos, moving tons of silt and debris, gathering speed and force as the frothing stew of mud, boulders, trees and debris flows downhill to the major watercourses in the valley – a flash flood.

There are dozens of small to medium washes that flow to larger streams and rivers in the valley, but all that water heads to the same place, eventually, the Santa Cruz River, with the two largest tributaries, Rillito Creek and the Cañada del Oro, joining the Santa Cruz within a half-mile of each other in the northwest part of the metro area. To complicate matters, there is a system of washes that flow through the densest populated part of the of the metro area heading for the Santa Cruz near downtown Tucson.

Left: The Rillito River experienced severe streambank erosion during the 1983 flood. Flowing water has enormous potential to move soil and large boulders, which can erode banks and turn formerly overbank areas into the main channel. Erosion hazard setbacks were established as a result of channel migration during large storm events.

Floodwaters have the potential to undercut and compromise the foundation of structures. Due to the threat of these damaging effects, the District has strengthened construction standards. These requirements now help protect people and structures from flood hazards.



In 1983, townhomes along the Rillito River were threatened by rising floodwaters and a lack of structural bank protection. The District has since utilized soil cement bank protection as a way to contain floodwaters, and prevent lateral erosion that helps protect overbank areas.

4,000 years of living at the mercy of the river

After the last Ice Age, the climate was much cooler and wetter in Southern Arizona. Mammoths, ground sloths, and bison drank from perennial streams and grazed on abundant grasslands. By 2,000 B.C., the area warmed and dried out and hunter/gatherer people began farming along the ribbons of water fed by mountain runoff. By 1,500 B.C., these early people dug irrigation canals along the Santa Cruz River and built check dams to capture runoff. Not much changed over the next millennia or so, even after the Spanish arrived in the late 17th century. Early Spanish settlers were at the same mercy of the rivers and rain as the indigenous people who came before them.

After the United States took possession of Southern Arizona via the 1854 Gadsden Purchase, mining and railroads created a population explosion and the watershed began a dramatic change. Arroyos carved deeply into the floodplains, streams went dry, water tables dropped, and farmers abandoned many fields. Woodcutting and overgrazing contributed to the environmental degradation, but large dams and canals had perhaps the most significant effect.

In 1888, Sam Hughes dug a small trench off the Santa Cruz River and let erosion widen and deepen the channel. Within a few months, his man-made arroyo eroded several miles upstream into the river channel. Subsequent floods drastically gouged out the river. This canal and others, plus large dams that washed out during big floods, caused floodwaters to rush faster, erode river banks, damage property, and take lives.

Early 1900s development—pavement in particular—aggravated Tucson's floodprone situation. Just before Christmas 1914, the Congress Street Bridge almost washed out and 25 people had to be rescued from treetops, housetops, and windmills. In 1929, a wash along Silverbell Road eroded to 500 feet wide. In 1945, floodwaters tore a 15-foot gap in a highway bridge south of Tucson. Four automobiles plunged into the raging torrent and 10 people drowned.

World War II military bases and production plants brought

prosperity to the West and rapid population growth continued into the 1950s and 1960s fueled by Cold War spending and G.I. Bill housing benefits. The county's population doubled from 1940 to 1950, and doubled again between 1950 and 1970. It tripled between 1970 and 2000. A 1952 cloudburst near Davis-Monthan Air Force Base flooded low-lying subdivisions and closed major roads. Huge floods hit again in 1953 and 1958, and a dozen cars were swept into raging washes in 1962. Tucson quadrupled its land area to include the new postwar suburban housing trend. Development stretched from mountain to mountain and beyond. New towns formed, Oro Valley, Marana, and Sahuarita, all three situated along rivers and major washes. New development upstream wreaked runoff havoc downstream. Entering the 1970s, it became increasingly clear a regional solution was needed.

The National Flood Insurance Program

Pima County wasn't the only county in the country beleaguered by repeated flooding. In 1968 after major hurricane and flood relief expenses in the 1960s, Congress passed the National Flood Insurance Act to direct construction away from floodprone areas, create damage-reducing regulations, assist floodplain residents after floods, and shift damage costs from taxpayers to renters and property owners via flood insurance premiums. To this end, Congress created the National Flood Insurance Program (NFIP), a partnership between the federal government and state, tribal, county, and municipal governments. To participate, all builders in NFIP communities had to obtain permits within federally designated floodplains and ensure that new development would be designed to address the flood risk and would not increase damage to other properties or create new flood problems.

Communities started to create their own standards, often more strict than federal rules depending on local conditions. They mapped their area's watersheds, assessed flood dangers, created building regulations, and issued floodplain building permits. NFIP participation was minimal in the first few years, but then the Flood Disaster Protection Act of 1973 made flood insurance coverage mandatory for any federal aid or federally-insured bank loans relating to buildings located in flood hazard areas.

The Arizona State Legislature that same year responded to the federal legislation by passing the Floodplain Management Act, which allowed counties and other local governments to create floodplain regulations that complied with NFIP requirements. The new federal and state laws came just in the nick of time. Long-time Arizonans remember that period as "The Soaking Wet '70s" due to an unusually active period of Pacific Ocean El Niño events, many numerous winter storms were routed over the state, creating flood after flood, especially in Maricopa County, home to the state's capitol and Legislature. In 1978 alone, the Federal Emergency Management Agency (FEMA) declared three national flood emergencies in Arizona. The flooding of the 1970s convinced state legislators that more had to be done.

In 1978 The Legislature mandated Arizona counties form regional flood control districts with taxing authority to construct flood control improvements.

The Pima County Regional Flood Control District

In 1978, Suzanne Shields answered an ad in the newspaper, passed a rigorous interview process, and became the newly-formed District's first hydrologist. She rose through the ranks to become the District's director in 2005, where she reports to the District's first director, Chuck Huckelberry, who is now the County Administrator. Shields and Huckelberry are the Pima County Flood Control District. Since its creation in 1978, the District has spent nearly $400 million building flood control infrastructure to protect over 1 million people and $9 billion in property (in terms of assessed value for property taxes). Every bit of that infrastructure has involved Huckelberry and Shields in one way or another (the District was combined with the Department of Transportation (DOT) in its early

As the then director of both the District and the Department of Transportation, Chuck Huckelberry (second from left) played a key role in the formation of Pima County. Here he and staff participate in a groundbreaking ceremony for the Craycroft Bridge spanning over the Rillito River.

days. It was separated as its own department in 2005.)

Shields' new job called for planning and problem-solving, analyzing watersheds, predicting flood peaks and identifying areas of high risk, and coming up with ways to lessen the impact of Pima County's devasting flash floods. Until 1978, flood warning and control was handled by DOT where Huckelberry, a civil and mining engineer, and Deputy Transportation Director John Bernal brainstormed long-range plans and created floodplain management standards with engineers including Mike Zeller and Terry Hendricks.

Shields worked with Bernal to create policies and plans and write drainage design standards. One of her first tasks was to determine where people were at risk. Shields describes Huckelberry as a visionary in crafting innovative ways to solve complex engineering problems with tight budgets.

For instance, when Tucson was expanding rapidly in the 1970s, the County struggled to build roads fast enough. The DOT needed fill dirt for roads and better drainage because the new houses increased runoff. The County dug detention basins to contain floodwater and used the dirt for the roads, combining projects to save money.

One district, many partners

The District doesn't operate in a vacuum. It works with all the local jurisdictions in the County, and relies on the state and federal governments as key partners. All of those alliances and partnerships comprise an integrated, multi-jurisdictional effort to predict and manage flood events. Those partnerships have lasted from the beginning. The state Legislature provided funds for the Arizona Flood Warning Office in 1979 and created the Arizona Department of Water Resources (ADWR) in 1980. This helped maintain Arizona's United States Geographical Survey Office's streamflow gauges and helped the National Weather Service improve flood prediction. After heavy statewide flooding in 1993, the ADWR created the Arizona Flood Warning System (AFWS). Comprised of local, state, and federal organizations it broadcasts real-time storm conditions and provides data for emergency and floodplain managers, weather forecasters, and the public. Also in the 1970s, the state created the Arizona Floodplain Management Program to coordinate state and regional compliance with the NFIP, assist local communities with federally-funded Community Assistance and Cooperating Technical Partners program, and publish local-level floodplain management criteria.

Historically many area residents that lived adjacent to washes would use inert materials to prevent erosion on the channel banks. This is a threat to downstream areas if that material were to become loose. District staff perform surveys of washes to determine clean-up efforts.

Public oversight

The Pima County Board of Supervisors serves as the Pima County Flood Control District's Board of Directors. The Board determines the District's annual budget, sets the flood control tax levy rate, and approves the District's overall direction and policies with input from the County Administrator and Deputy County Administrator Carmine DeBonis. To better include public input in the decision-making process, the Board created the Flood Control District Advisory Committee in 1988. Made up of citizens and professionals, the 12-member committee represents each incorporated community and unincorporated residents in Pima County. They submit recommendations to the Board on floodplain management and flood control issues.

Turn around, don't drown

While the District has been remarkably successful building the infrastructure needed to direct millions of gallons of water into rivers and streams and safely through metro area, it doesn't mean that heavy storms and millions of gallons of water rushing about town isn't life threatening. Storms, especially flash floods, remain incredibly dangerous and too many people die every year in Arizona after getting swept away in a storm, often trying to cross a flooded road.

One of the most difficult tasks for the District has been convincing the public that there are serious hazards and risks connected with Arizona's flash floods. The District constantly improves its life-saving messages so that people know how to use the available tools and how to act safely in dangerous flood situations.

It publishes brochures and handouts on various water-related topics and produces online informational videos and short audio public service announcements for local radio stations. And to increase flood safety and water conservation awareness in children, the District created a free downloadable coloring book with fun facts about desert animals, humorous quizzes, and a cartoon character named Hank Highwater. District staff are frequent guests in dozens of classrooms in the County, teaching youngsters how to be safe during storms and educating them on the power of rushing water.

The District's website has an enormous amount of information available, some of it for the general public, but most of it intended for researchers, engineers, developers, land planners and others.

Nearly half of all flood deaths are vehicle-related. When the buoyancy force is greater than the weight of the vehicle, water can carry a car downstream. The depth of water flowing across a road is not always obvious and the roadbed may have washed away under flowing water. Always respect signs and warnings and remember to "turn around, don't drown".

The great flood of ’83 and the lessons learned

At the end of September and beginning of October 1983, approximately seven inches of rain fell over Pima County within a seven-day period, with four of those inches falling in one day. The main cause of the deluge was Tropical Storm Octave, which began off the west coast of Baja California. It merged with a cyclone off the Gulf of California and then the combined storm stalled over Tucson. Nine people died in Pima County, 221 people were injured and more than 400 flood victims were rescued or evacuated from flooded areas.

Weather satellites and early warning systems were in their infancy at the time so while the National Weather Service and other emergency preparedness agencies knew a big storm was coming, few realized that a perfect storm was brewing and heading for Arizona. It had rained in mid-September and heavily on Thursday, September 29, but on Friday it was sunny with not a cloud in the sky. Then after midnight it started raining... and raining... and raining.

Power line towers, bridges, roads, water and sewer lines, and more got wiped out. Where the Cañada del Oro Wash joined with Rillito Creek and the Santa Cruz River, it looked like a huge firehose had been blasted across the terrain. Flooding

Erosion of channel banks along the Rillito River undercut many structures and affected the lives of many Pima County residents. The District has since established safe building setbacks from the banks of regulatory washes to keep new development safe.

Left: Tucson Police Department officers rescue a citizen from flooded waters during the 1983 flood. Unfortunately, during the storm event two helicopter crewmembers from the Arizona Department of Public Safety were killed while performing rescue activities.

Estimates by the Federal Emergency Management Agency (FEMA) state that 154 residential units were destroyed, 160 suffered major damage, and 222 received minor damage as a result of the 1983 flood. While an exact number is unknown, the Picture Rocks Fire District and Rural Metro Fire Department estimate 400 persons were evacuated from their homes for medical or safety reasons.

on the Santa Cruz and Rillito was the largest in the County's recorded history. Rivers jumped their banks and inundated lowlands like Marana, where the Santa Cruz River became three miles wide in places. Blocked roads and toppled bridges cut off some areas for days. Over 150 homes were destroyed by water, debris, and mud within the Santa Cruz River basin and 160 homes sustained major structural damage. Flood damage was estimated at $226.5 million ($556 million in 2018, adjusted for inflation) including $58 million in damages to public facilities in Tucson and Pima County.

When developers built along the Rillito they never expected the river would ever flood as wide as it did in 1983. Current District Director Suzanne Shields watched when the water undermined a townhouse

Residents float along the Rillito River during the 1983 storm. While it may be unique to swim within flooded washes during storms, there can be unexpected consequences. Playing in and near washes can put you and emergency responders in danger.

foundation. "I was there when it was falling," Shields said. "The river curved there and you could see it happening. It was a sand/clay bank but it was getting saturated and you could see these cracks and large chunks of the bank would just slough off." Then the wall of the townhouse fell, and seconds later the whole building collapsed into the rushing floodwaters.

As Shields and others in District examined the devastation and prepared reports and plans for recovery, they noticed something that would be extremely important for future flooding. An early District project that built $4 million in soil cement bank protection on the Santa Cruz and Rillito Creek west of Oracle Road stood up to the raging waters and prevented an estimated $15 to $20 million in damage to nearby properties.

Soil Cement, the Savior of Pima County

The flood of 1983 changed everything. This unusual storm showed District staff that their computations greatly underestimated the amount of flow possible in these rivers. The rivers had stayed in the same channels for decades, but this time, floodwaters gouged out deeper and wider channels or jumped their banks and meandered as much as 1,000 feet. One reason Pima County got so much federal help after the 1983 flood was that the District convinced federal agencies that the County couldn't just replace what the flood destroyed because you can't put back an abutment when the river is nowhere near it anymore.

The District adopted soil cement as the preferred bank protection method which facilitated construction of DOT bridge construction projects, helping to make them larger and stronger and allowing more water to flow under them. Soil cement is natural soil dug from the river that is combined with a small amount of Portland cement and water that forms a rigid durable material when applied to river banks. The soil cement extends well below the river bottom, preventing undercutting, and well above to contain extreme flows similar to 1983. After the experience of the 1983 flood, Shields, who was then the Planning and Development Division Manager, was the primary author of a research paper on the use of soil cement in Pima County flood control projects. The paper showed that soil cement is effective, economical, practical, and environmentally attractive. Shields' research and Pima County's success with soil cement prompted the U.S. Army Corps of Engineers (Corps) to recommend its use in other areas of the country where the conditions are appropriate. In 1986 the Corps estimated that without these improvements the average cost of flood damages per year would be $6.5 million. The District has used soil cement on all the major watercourses in the County and will continue to until a better, more cost-effective solution is found.

Soil cement embankments also presented Pima County with a serendipitous recreational opportunity – the tops of the embankments that were paved for controling dust turned out to be a great place to build a multi-use trail for the public.

The Flood of 1993

Every flood has its abnormal conditions that make it unpredictable, and in 1993 it was the time of year and storm duration. Several inches of rain fell in short spans of time on Thursday, January 7, again on January 8, and then another storm the next day dropped two more inches. That rain saturated the soil and then another storm struck on January 18. One inch fell in 2.5 hours with a total of 1.39 inches for the day, accompanied by snow melt, providing large volumes of floodwaters. It had been less than 10 years since the Flood of 1983, yet despite the Rillito Creek reaching or exceeding in some places 100-year flood levels, the lessons learned from the Great Flood and the improvements made over that decade kept the water in the river. No one died and property damage was considerably less.

The Landslides of 2006

The year 2006 broke records for rainfall and streamflow in Pima County, even more than the Flood of 1983. The total rainfall for June, July, and August was 8.6 inches, two inches more than average. By September, 10.2 inches were recorded at Tucson International Airport. In mid-July, rains saturated upper watershed soils, especially in the Rillito-Tanque Verde-Pantano system. Then Tropical Storm Emilia brought in moisture from the Gulf of California and from Thursday, July 27 to Monday, July 31, total rainfall ranged from five to 15 inches in the Rincon and Catalina mountains while some parts of the valley received at least six inches. The total in the Catalinas was 50 percent more than in 1983. The 2006 storms produced the most intense, numerous landslides in perhaps the last 10,000 years. There were more than 400, some of them massive. Some slides were 80 percent solids and moved like a lava flow. In Soldier Canyon next to Sabino Canyon, debris flows picked up a rock nine feet in diameter and shoved it up under a concrete bridge. It took many days and lots of heavy equipment to dig it out.

Using local soils with a mix of concrete, soil-cement bank protection helps contain floodwaters within the streambed channel. Prior to installation, construction crews remove any foreign objects embedded with the banks such as vegetation, inert material, and even cars!

However the outcome was far different than the 1983 and 1993 floods. Perhaps the most remarkable aspect of the 2006 flood was that the rain fell mostly overnight and, in the morning, County residents awoke and went about their daily routines, going to work and school, noticing there was a lot of water in the rivers but not realizing they were experiencing a major flood event. On Rillito Creek, the soil cement bank protection built in the 1980s protected all public structures and private property except for a small section near the Campbell Avenue Bridge. Without the consistent bank protection, well-constructed bridges, land purchases in floodprone areas, improved floodplain ordinance regulations, and land use policies, the public could have suffered an estimated $500 million in flood damages because of the record-breaking flows. And most importantly, no lives were lost and only minor injuries sustained.

A history of innovation

There is a lot more to flood control than strengthening the sides of rivers with soil cement. The District strives to be proactive about conducting watershed and basin studies to help form its planning and capital improvement priorities. To that end, District hydrology experts and engineers examine the power and scope of large watersheds and storm systems. They look at the big picture and see the full range of management, control, and preservation needed to solve long-term problems with practical and far-reaching solutions. Innovation has been a hallmark of the District. Before humans moved in next to rivers, rivers would overflow their banks during floods, spreading out and slowing down. The power and force of the water was spread out over a wide area, minimizing the flood's damaging effects. By concentrating water into tight channels, the force is amplified and becomes more destructive. The District has looked for opportunities to return the watersheds, when possible, back to the way nature dealt with floods – wide and slow. In doing so, it has also sought to restore ecosy stems, providing ancillary benefits to the community. The sections below are a sampling of the District's ingenious programs and projects that not only protect life and property, but improve quality of life too.

Floodprone Land Acquisition Program

Motivated by the loss of life, great personal injury, and tragic loss of countless homes and businesses from the 1983 flood, Pima County voters authorized the County's first flood repair bonds and that also funded a vigorous Floodprone Land Acquisition Program (FLAP). Some funding went to purchase open lands, but the priority was to buy out the people whose homes had been flooded or destroyed at pre-flood property values. These County-acquired lands remove people from harm's way, but there is also an economic incentive. When Pima County took this major step, FEMA was more willing to provide funding for flood control. Many homeowners would have declared bankruptcy and banks would have taken major losses. It would have been nearly impossible to get mortgages to rebuild in those areas, so FLAP aided Pima County's economic stability. This was the case after the Aspen Fire in 2003 in the Catalina Mountains when monsoon storms washed tons of ash and debris into the Cañada del Oro Wash and their properties. People have also donated

Left: The Arroyo Chico Basins are part of a multi-purpose project that provides flood damage reduction, environmental restoration and recreation benefits. These basins help contain floodwaters from tributary washes and natural drainage areas. The project has removed the 100-year floodplain from over 2,200 residential, multi-family, commercial and industrial structures.

land to the County to keep riparian areas natural.

The most important lesson learned from the 1983 flood was the value of the natural floodplain. Continued bank protecting and channelizing the watercourses, corralling water into manmade channels just creates faster, more destructive runoff. There have to be natural slow areas where the rushing water can go to slow down and sink in. FLAP makes this possible.

FLAP is a willing seller/willing buyer program. Property owners may request that the County purchase their property and if the property is in a high flood hazard zone, the District will probably purchase the land if funding is available. The District has purchased over 7,000 acres of floodprone land throughout Pima County. One of the District's major purchases involved nearly 4,000 acres of land located along Cienega Creek. This provides significant flood control benefits, but also preserves the habitat and helps recharge aquifers along the major watercourses.

There are many types of jetties used for erosion protection within washes. These jetties help to induce sedimentation in eroded areas and re-establish channel topography. As a result, water then moves within the wash channel and helps to restore and replenish natural vegetative areas.

Habitat Restoration

Restoring riparian habitat was the District's dream right from the beginning, but there wasn't much funding for it. The District started by identifying key watercourses and created a map of prime areas where the habitat should remain natural. Attitudes toward habitat restoration began to change with the federal Clean Water Act of 1977, and where the Corps of Engineers had previously just done repairs and flood mitigation, it now added habitat restoration and public recreation to their programs. Pima County has had the good fortune to get more Corps projects than other similar-sized communities because the District is a centralized regional taxing authority and is able to acquire enough land to make restoration possible. Restoration and recreation area plans along Rillito Creek were set in 1984, but the Corps had not yet started construction when the flood of 1993 hit.

Once land was acquired, and bank protection built the County paved pathways for utility and District maintenance workers. Not long after that the planners decided to open the paths to the public, creating river parks and places to bicycle, jog, or walk. After the bank protection and river parks were finally finished, land values in the restored areas increased more than 1,000 percent. Often the Corps did feasibility studies for Pima County watersheds and then the District would then get bonds passed to build Corps-designed projects. The District has completed 10 restoration projects and is actively working on four more. The completed projects are: Arroyo Chico Multi-Use Project; Big Wash Restoration; Cañada del Oro Ecological Reconnaissance; Cienega Bottomlands Restoration Project; Cortaro Mesquite Bosque Construction Project; Kino Environmental Restoration Project (KERP); Pantano Jungle Restoration Project; Paseo de las Iglesias Phase I: Santa Cruz River Bank Protection, Ecosystem Restoration, and Linear Parkway, Ajo Way to Silverlake Road ; Rillito Creek/Swan Wetlands Ecosystem Restoration Project; Lower Santa Cruz River Living River Project.

An aerial view of the Kino Environmental Restoration Project (KERP). This project was the result of the desire to redevelop the existing unlined Tucson (Ajo) Detention Basin into a new stormwater detention area that was more environmentally sensitive and aesthetically pleasing to the community. The multifaceted KERP facility was designed to meet three primary purposes – create native ecosystems, harvest urban storm water and control flooding.

Kino Environmental Restoration Project

Pima County's first major flood control measure, the Tucson Diversion Channel (authorized in 1948) created a long concrete and earthen channel that collected rainwater runoff from Davis-Monthan and Tucson's expanding eastside and southside residential areas. It channeled the water into the Santa Cruz River south of downtown Tucson and directed water away from the air base but made flooding worse downstream. Then in 1966, the Corps built the Ajo Detention Basin near south Country Club Road and Ajo Way

area to collect this excess water. It was a 90-acre flat-bottomed pit, an ugly mud flat with scrub trees and grasses along the rim.

Finally, in 1999, Congress authorized the Ajo Detention Basin Environmental Project, eventually renamed Kino after a nearby parkway named for 18th Century Spanish Jesuit missionary Eusebio Kino. Building on the original 1966 Ajo Basin, its purposes were to continue controlling floodwaters, harvest stormwater for irrigation use, and restore the natural riparian habitat around the basin. Completed in 2001, the project was jointly funded by the Corps and Pima County and now provides flood control and environmental benefits over 141 acres. KERP captures rainwater from a 17-square mile watershed, diverting stormwaters that flow downhill from Davis-Monthan to the Santa Cruz River. It can temporarily detain over 400 million gallons of water, releasing it downstream at much slower rates. The project includes an improved 50-foot-deep, 5.6-acre pond, 28 acres of open and riparian watershed, 21 acres of grassland, several smaller ponds surrounded by native willow, ash, cottonwood trees, a mesquite bosque, upland and marsh vegetation, a 2.2-mile bike and pedestrian path around the basin, and another 92 acres that include flood control structures and an earthen berm around the basin.

The District installed an energy dissipator located on the West Branch of the Santa Cruz near the confluence of the main stem of the Santa Cruz River. This infrastructure is designed to slow down moving water while also not allowing it to pond and drop sediment, and helps to prevent erosion in immediate downstream areas.

This basin collects and supplies stormwater that is used for irrigation. The streams are fed by an elaborate stormwater recirculation system, and these streams support over 30 acres of open water ponds, emergent wetlands, ephemeral cienegas, stream courses and mesquite bosque ("forest" in Spanish) - all of it surrounded by nearly 100 acres of upland vegetation.

The project's massive water harvesting system irrigates the athletic fields of Kino Sports Complex and landscaping at Banner University Medical Center South, the Abrams Public Health Center, Sam Lena Park, Kino One Stop Center and the criminal justice facilities along Ajo Way. KERP's irrigation water has saved taxpayers an estimated $6 million since its creation, re-couping its $6 million cost of construction by the end of 2018.

The project's detention ponds are popular with birdwatchers because they attract and sustain a myriad of birds from great blue herons, neotropic cormorants, and other species not usually seen on the edge of a desert city. But above all, the project saves lives and protects homes, businesses, and public infrastructure downstream. It is an engineering wonder and delegations from Mexico, Central America, Romania, and Mongolia have visited this model water harvesting site.

The detention basin at Cherry Field helps to retain and control the flow of water through surrounding urban drainage systems.

KERP's effectiveness was put to the test on September 5, 2011, when Davis Monthan Air Force Base recorded 2.64 inches of rain and stormwater flowed along the Tucson Diversion Channel into KERP at 16,000 cubic feet per second (cfs) filling the detention basin to the highest level on record. If KERP and the other detention basins such as Rodeo Wash, Kolb Road, Arroyo Chico, and Cherry Field had not been in place that day there would have been flood damage as disastrous as the major floods of 1978, 1983, and 1993.

Arroyo Chico Multi-Use Project

Beginning in the 1980s, the District, City of Tucson (City), and Corps worked together to create the Arroyo Chico Multi-Use Project, the first and largest combination of flood control, environmental restoration, and recreation undertakings in Tucson. The project impacts 11.4 square miles of drainage surrounding almost five miles of the combined Arroyo Chico/Tucson Arroyo waterway and its tributaries that flow from

Alvernon Way to their confluence with the Santa Cruz River on Tucson's west edge near Saint Mary's Road.

The Corps played a major role in the planning and design of the 20-year project. A major phase, the Park Avenue Basin, was completed in 2015 with $46.6 million in federal funds and $26.6 million leveed by the District as secondary property tax. Beginning east of the Randolph Golf Complex at Alvernon and 22nd Street, Arroyo Chico runs through underground culverts and above ground channels to keep floodwaters moving and channeling stormwater runoff into retention zones. The first phase, the Randolph South Detention Basin at the city's Dell Urich Golf Course was completed in 1996. The second phase of the Arroyo Chico project was completed in 2008 with the construction of the Cherry Field Detention Basin. The Cherry Field basin functions when there is a 20-year or larger storm. Runoff is channeled in and detained for about 30 hours, greatly reducing the amount of peak flooding that used to threaten the Fourth Avenue Business District and downtown Tucson. The project takes 2,200 homes out of the 100-year floodplain. The Park Avenue Detention Basin helps preserve riparian habitats, restore degraded riparian areas, and provide neighborhood recreational facilities. As the largest flood management project, Arroyo Chico is a major reason that the District gets such high ratings from the federal government. In most cases, property owners who had been in the floodplain areas around Arroyo Chico no longer have to purchase flood insurance.

Paseo de las Iglesias Project

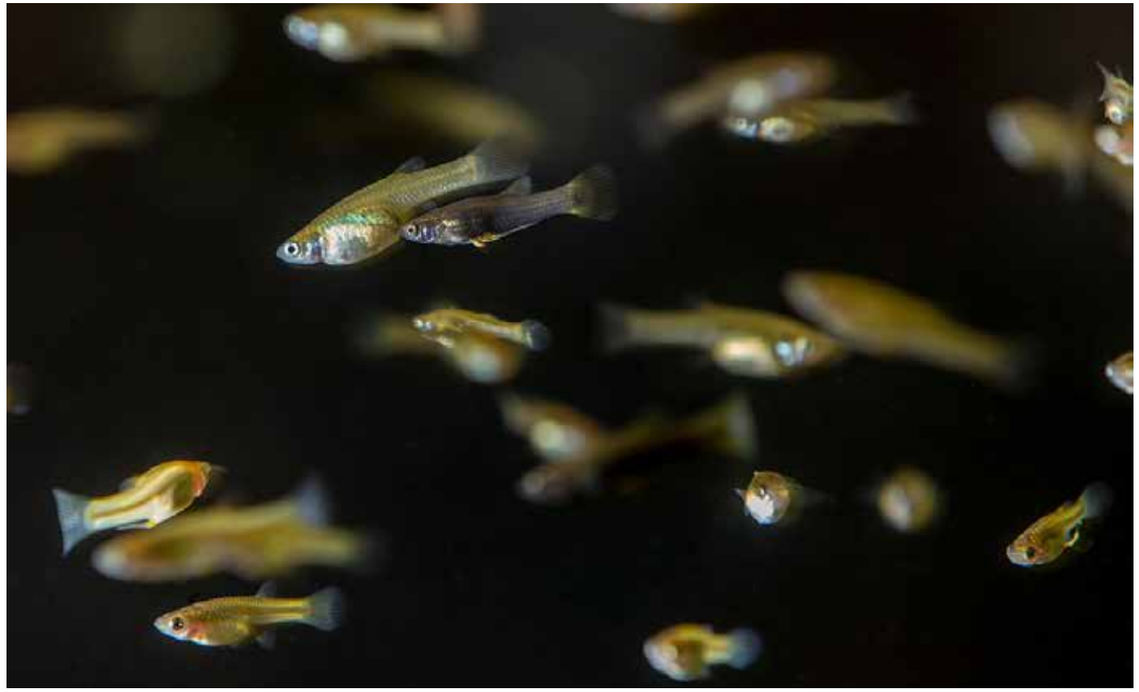
In 2004, County voters approved a bond that provided $14 million for erosion control along the Santa Cruz River from Ajo Way to Silverlake Road. The project opened in May 2015. It includes flood control improvements, ecosystem restoration, a river park, and both paved and decomposed rock pathways. Throughout the area, attractive illustrated signs describe the prehistory, history (including Padre Kino's missions and the Anza Trail) and the rejuvenated habitat. Tucson Pima Arts Council and Las Artes Arts & Education Center assisted with designs and decorations and more than 10,300 cacti, shrubs, and native trees, grown mostly by the Pima County Native Plant Nursery were added to the 400-acre area. The project provides 1.4 miles of soil cement protection, 0.4 miles of gabion bank, as well as terracing, rock plating, and riprap. Construction repaired headcutting erosion and increased water collection, added mesquite trees and a deeper pool with improved living and breeding conditions for nine unique and special interest herpetological species at the Mesquite Circle Pond.

Automated Local Evaluation in Real Time (ALERT)

The District operates and maintains a network of almost 200 real-time sensors used to collect hydrometeorological data that provides information to County personnel and other agencies about precipitation, stormwater runoff, and weather conditions affecting regional watersheds - all available to the public online for both personal computers and mobile devices. Using radio telemetry, ALERT system sensors transmit data in real-time to base station computers at the District's office and the Tucson office of the National Weather Service (NWS). The National Weather Service uses those data to assist in issuing flood watches and warnings and to determine rainfall estimates. In addition, the ALERT website displays weather and streamflow data from over 40 additional gauging sites run by partner agencies including the NWS, U.S. Geological Survey, Arizona Game and Fish, and Pinal, Cochise and Santa Cruz counties.

Lower Santa Cruz River Living River Project

In its largest public works project ever, Pima County in 2013 made major upgrades to its two major regional wastewater treatment plants, resulting in significant improvements in the quality of reclaimed water being discharged into the Santa Cruz River. Since then, the river has undergone a transformation, now supporting a vibrant habitat for wildlife, birds, insects and fish, including the endangered native Gila topminnow which returned to this reach of the river for the first time in 70 years. The District monitors progress in the Lower Santa Cruz's ecosystem with help from several other County departments and outside agencies, notably the Sonoran Institute using its EPA-funded "Living River" series as a model for reporting. An important element of public outreach has been the Living River of Words youth poetry and art contest. Participating local students from five to 19 years old learn about watersheds and wetland habitats through a multi-disciplinary series of science investigations, then interpret those lessons through the verbal and visual arts. Winning entries are featured in a traveling exhibit that tours the County for the following year.



Pima County Wastewater treatment plant upgrades have led to an increase in effluent discharge quality and quantity within the Santa Cruz River. Natural habitats have been restored within the effluent reach and endangered species such as the Gila Topminnow have begun returning to the river system. The Lower Santa Cruz River is now home to a variety of local flora and fauna.

The Automated Local Evaluation in Real Time (ALERT) gage at Elephant Head Butte is just one of almost 200 different sensors that help the District monitor precipitation, streamflow, and weather events at a localized point. The sensors are programmed to report rain and stream flow to a central data gathering and dissemination system, where highly experienced District personnel monitor the data and help alert emergency responders to the presence of hazardous conditions.

The work is never done

Floods are difficult to predict, and there may always be a flood larger than the last one. There are new factors involved now as well. Climate change is altering weather patterns and increasing the intensity of storms and flood events. It is also changing the regional ecology. After the 2003 flood that followed the Aspen Fire, hydrologists and engineers learned that as more fires occur because of climate change, flood risks increase because there are fewer plants to anchor the soil and ashes turn to silt and increase runoff speed and volume.

Bank stabilization, preventing unwise encroachment in floodplains through floodprone land acquisition, and a strong and effective floodplain management and regulatory programs have significantly reduced flood damage from record flood flows that have occurred since 1983. But what has been built must be maintained, and continued population growth requires constant reevaluation of plans and projects.

In 2018, the Regional Flood Control District began drafting a new countywide Floodplain Management Plan with the intent of improving the County's standing under the National Flood Insurance Program's Community Rating System (CRS). Currently, Pima County qualifies as a Class 5 community under the CRS, ranking it among the best in the nation. The classification also gives County residents the ability to receive a discount of up to 25 percent on flood insurance premiums. To qualify for the higher Class 4 rating and be granted a 30 percent discount, the County must complete a public floodplain management planning process. The purpose of the plan is to review flood hazards and mitigation activities watershed-by-watershed, and develop strategies to reduce flood damage and risk. The entire process is expected to take approximately one year. Successful completion of these pre-requisites may result in Pima County receiving a rating of Class 4 or perhaps even Class 3, and becoming one of the top 15 communities in the nation out of nearly 1,300. Just as safe drivers get lower auto insurance premium rates, property owners in communities that demonstrate consistently reduced flood risks receive discounts on flood insurance.

The District has done a remarkable job in the past four decades, but many flood problems remain. The community's continued growth will always present new challenges for watershed management. But we are fortunate to live in an area where so many organizations work together to protect and enhance the beautiful Sonoran Desert community and will continue their tradition of protection, dedication, and vision. Moving forward, the District's goal is to become the regional flood control planning, operators and management agency for all of Pima County, including incorporated areas, and also assist adjacent counties that may lack the capacity to meet their needs and achieve their goals. For example, the District has begun the process of taking operational control of flood control efforts in the Cañada del Oro Wash, the Santa Cruz River in the City and on Big Wash in the Town of Oro Valley and as well as providing significant planning and logistical assistance to Santa Cruz County.

Major drainages and watercourses

Pima County is the size of New Jersey and the eastern County where most of the people live is over 2,000 square miles with six mountain ranges that contribute to flooding in the metropolitan area. To coordinate and prioritize its flood control projects, the District divides the County into major watersheds. A description of some of the largest follows.

Santa Cruz River

The 210-mile Santa Cruz originates in Santa Cruz County's San Rafael Valley set between the Patagonia Mountains and Canelo Hills then flows south into Mexico for a 25-mile stretch before looping back north into the United States just east of Nogales. It enters Pima County just north of Amado, flanked by the Santa Rita Mountains on the east and the Cerritos on the west. All of the larger watercourses in the Tucson metro area flow into the Santa Cruz making it the most significant river in the County. The Santa Cruz provides fertile farmland in the Tucson basin, allowing for the longest continuous human habitation of any location in the Western Hemisphere. The close proximity to populated areas has required significant investments in flood protection infrastructure, confining the river's course in a jacket of soil cement for most of its run through metropolitan Tucson. The river returns to a more natural state as it leaves Pima County amid the farmland of Marana. It widens considerably finally becoming a highly-braided alluvial fan through Pinal County that only occasionally flows above ground to the Gila River. The Santa Cruz River and the San Pedro River to the east of Pima County, are the only rivers in North America that flows north for most of its length.

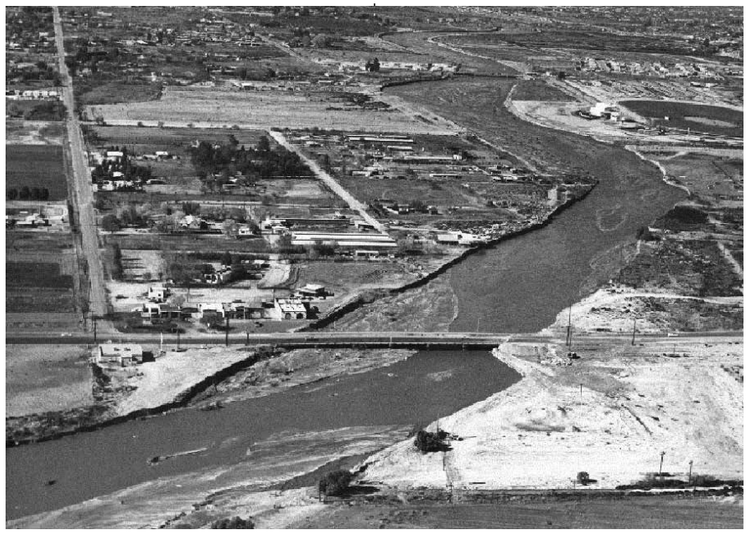
Even during floods, construction crews install the Continental Bridge at the Santa Cruz River in Green Valley in 1978. A stream gage was also installed on the bridge in order to monitor the depth of the water within the channel.

Rillito River

Rillito River begins at the confluence of the Tanque Verde Creek and Pantano Wash at Craycroft Road, running across Tucson's north side at the base of the Catalina Mountains to its confluence with the Santa Cruz River. The river's watershed includes dozens of washes that drain from the flash floodprone Catalina Foothills and City of Tucson's urban wathersheds and plays a significant role in groundwater recharge. It is largely contained in the channel by numerous flood control projects.

Pantano Wash

Pantano Wash travels north along the Rincon Mountains and begins near the community of Vail at the confluence of Cienega and Aqua Verde Creeks and it is further fed by its main tributary, Rincon Creek. Once home to many sand



The Campbell Bridge crosses over the Rillito River in 1965. Bank protection and building requirements have now turned this area into various commercial centers that are protected from the 100-year flood.

The Cienega Creek Natural Preserve is most noted for its ecological significance and scenic beauty as a desert riparian oasis. In addition to its ecological importance, the Preserve provides a link to our past and serves to accommodate present and future generations.

and gravel operations, its channel is prone to lateral migration in its undeveloped, upstream sections. Named for the Spanish word for "swamp," the Pantano once featured many marshy areas in its middle reaches that disappeared with the development of metro Tucson.

Tanque Verde Creek

The Tanque Verde Creek watershed includes the Tanque Verde Creek and two of its largest tributaries, the Aqua Caliente Wash and Sabino Creek. The creek's headwaters originate on either side of Redington Pass in both the Rincon and Santa Catalina mountains. This watershed contains some of the largest networks of springs, surface flows and shallow groundwater anywhere in Pima County. The Tanque Verde is prone to large flash floods that can cause significant damage to homes and property and frequently closes road crossings, limiting access in the area.

Cienega Creek

The Cienega Creek headwaters originate in Santa Cruz County in the Canelo Hills south of the community of Sonoita. Tributaries draining the eastern slopes of the Santa Rita Mountains and the western slopes of the Whetstone Mountains join it. Running along the east side of State Route 83, it passes under Interstate 10 and joins the Agua Verde to form the Pantano Wash near the community of Vail. This watershed contains one of the last reaches of perennial flow in Pima County and is considered an Oustanding Arizona Water by the State of Arizona.

Bridge improvements over the Canada del Oro Wash offer scenic views of the Catalina Mountains and allow users to cross safely over the wash channel during times of flooding.

Sabino Creek

Sabino Creek begins flowing at nearly 9,000 feet, near the summit of Mount Lemmon and the community of Summerhaven. It descends steeply through canyons before spilling out onto the bajada foothills and then into Tanque Verde Creek. It has been the centerpiece to one of the Tucson area's most popular outdoor recreation spots since the 1930s when New Deal infrastructure programs built a road and bridges 4.5 miles into Sabino Canyon running along and over the creek. Its lower section cuts through a spectacular narrow canyon protected as the Sabino Canyon National Recreation Area that is quite popular with hikers, bikers and tourists who frequently get stranded during flash floods.

Cañada del Oro Wash

The headwaters of the Cañada del Oro (CDO) originate in the Santa Catalina Mountains at an elevation of 8,000 feet. Two of its largest tributaries, Big Wash and Sutherland Wash, drain the western slopes of the Santa Catalina Mountains and the eastern slopes of the Tortolita Mountains. The CDO and Big Wash enter Pima County from Pinal County near the community of Catalina. The wash has very steep and rocky upper slopes that make flash flooding a significant concern and wash crossings potentially extremely hazardous. Fires on Mount Lemmon can significantly

increase the risk of flooding in this area, as was the case following the 2003 Aspen fire.

Tenmile Wash (Ajo area in general)

Tenmile Wash begins just east of the community of Ajo in the central county and extends from the Pozo Redondo and Batamote mountains in the east across the basin floor to the Little Ajo and Childs mountains in the west. From those headwaters, the watershed then drains northward into Maricopa County. It is the only major waterway in Pima County that does not run into the Santa Cruz River and remains largely in its natural state with very little infrastructure aside from the Curley School Detention Basin.

Other drainages

Brawley Wash

The largest watershed within Pima County in terms of area, the Brawley Wash flows northward toward Pinal County where it joins the Santa Cruz River. Its headwaters, as well as those of its tributary Blanco Wash, originate in the Roskruge and Coyote mountains south of the community of Three Points/Robles Junction. The Altar Wash and Black Wash are also significant tributaries. The watershed is often prone to sheet flooding and the only infrastructure of note are road crossings on the Tohono O'odham Nation, limiting access to rural communities.

The Mile Wide Road Bridge over the Brawley Wash was partially washed away during a flood event in 1962. Access was cut off for some area residents, putting their and emergency responders lives at risk.

Altar Valley

The Altar Wash drains the eastern slopes of the Baboquivari Mountains as well as the western slopes of the Sierrita Mountains south of State Route 86 and extends to the south over 30 miles to its headwaters near Mormon and Aguirre lakes within the Buenos Aires National Wildlife Refuge. Its major tributary is Arivaca Creek.

Black Wash

The Black Wash's headwaters originate on Black Mountain within the San Xavier District of the Tohono O'odham Nation. Tributaries from the northeastern slopes of the Sierrita Mountains south of San Xavier join it along with those emanating from the southwestern slopes of the Tucson Mountains. These combined flows join the West Branch of the Brawley Wash near Sandario Road.

San Pedro River

The San Pedro River originates in Mexico and flows through Cochise County prior to entering Pima County where it drains the eastern slopes of the Rincon and Santa Catalina mountains before exiting into Pinal County south of the community of San Manuel. Though it is one of the largest watercourses in Pima County, its remote and rural nature means few people interact with it here.

The Chuck Huckelberry Loop

The Chuck Huckelberry Loop is a system of paved, shared-use paths and short segments of buffered bike lanes built on top of soil cement banks along the regional watercourses and that connect the Rillito, Santa Cruz, and Pantano River Parks with the Julian Wash and Harrison Road Greenways.

The Loop's origins spring from Pima County's response to one of the most devastating disasters in the community's history— the 1983 Flood.

After the floods, the District adopted a more active floodplain management philosophy and set to work on a network of bank protection projects along with property acquisition and ecosystem restoration efforts all designed to protect hundreds of acres of land from future flooding and provide emergency and maintenance vehicles with easier access to the river channels.

Shortly after the District completed the first sections of soil cement banks, District staff noticed the public had started using the tops of the banks to go for walks and bike rides, with even some people riding their horses. The District got an idea to pave a four-mile stretch along Rillito Creek and it became enormously popular, to the point of being overcrowded.

A Loop project in the mid-1990s, along the Rillito River at La Cañada Dr., shows an underpass being paved which allows users to safely cross roadways without having to make dangerous crossing in vehicle traffic. A majority of the Loop is built with connections to local roads and parks to allow people to commute to work, ride their bikes, or a go for a walk in a car free environment.

A completed section of the Loop near downtown Tucson shows the benefits of long-term urban planning efforts where the built environment meets the natural surroundings. Local businesses are choosing to build near sections of the Loop to offer their employees convenient access to nature areas.

Taking a moment to relax, two local residents safely watch the floodwaters within the Santa Cruz River after a storm event. It is not uncommon to observe coyotes, roadrunners, and a variety of other wildlife living along Loop corridors. Keep your eyes open!

A group of trail users approached the County to expand the trail system along the other embankments in the County, possibly creating a "loop" around the metropolitan area. The District and County Administration thought it was a great idea and began a 20-year program of building shared-use paths wherever feasible. In 2018 the County celebrated the connection of the metropolitan Loop, creating a 55-mile ring of shared use path.

Today, the soil cement used to shore up the edges of the Santa Cruz River, Rillito Creek and other waterways is the backbone of a remarkable 131-mile linear park system. There are extensions along the Cañada del Oro into Oro Valley, and the lower Santa Cruz into Marana.

The asphalt path is 12-feet wide in most places, but it may be wider or narrower depending on location, such as street connections and bridge underpasses. Whenever possible, the path meets accessibility guidelines specified under the Americans with Disabilities Act. Alongside the paved path usually is a four- to eight-foot wide shoulder made from decomposed granite that sometimes meanders off into landscaped or natural areas where there is sufficient space. Every Loop project also includes landscaping that restores the area to its natural state — a federal requirement.

Not every mile of The Loop sits atop a river bank and those are the County's Project Management Office's responsibility. Funding for projects such as the Harrison Greenway, portions of the Julian Wash segment and new Rillito River Pathway Bridge over Camino de la Tierra come from a variety of sources, including federal grants. Some smaller projects even had private money from developers or donor funding.

The Loop took hundreds of millions of dollars in flood control infrastructure investment and upgraded them into one of the finest public recreation facilities in the Country. The immensely popular Loop remains a work in progress. The last big project completed is at the confluence of the Santa Cruz River, Rillito River and the Cañada del Oro Wash – the corazón, or heart, of the Loop. Other projects plan to extend the path along the Tanque Verde, creating a connection to the Sabino Canyon National Recreation Area, north along the Cañada del Oro to the Pinal County line, east to the Pima County Fairgrounds and south toward Green Valley.

To learn more about The Loop, go to www.pima.gov/theloop.

Pima County RFCD timeline

Rillito Creek – looking East – 1966

1968 – The National Flood Insurance Program (NFIP) is established by the Federal Emergency Management Agency in order to address nationwide flooding.

1974 – The Pima County Board of Supervisors adopt the District's first Floodplain Management Ordinance.

Rillito Creek – 1978

1977 – In October, Tropical Storm Heather delivered days of storms with rainfall totals reaching 14 inches in some areas. Flooding caused the evacuation of 700 people and severe agricultural damage along the Santa Cruz River.

1978 – The Arizona Legislature enacted laws requiring county governments to create flood control districts with taxing authority to fund flood control improvements. Pima County Flood Control District is formed.

Santa Cruz River – October 1977

1979 – The first soil cement bank protection is constructed in Pima County, along the Santa Cruz River near downtown.

1981 – In July, flooding in Tanque Verde Creek sent a 10-foot tall wall of water rushing over Tanque Verde Falls, which swept away eight people, all of whom died.

Pantano Wash – 1983

1983 – On February 15, Pima County becomes a National Flood Insurance Program Community allowing for citizens of Pima County to obtain flood insurance.

1984 – In response to the 1983 flood, the District implements the Floodprone Land Acquisition Program (FLAP) to purchase flood-damaged property, and begins installing the ALERT flood threat recognition system throughout Pima County.

1983 – In October, powerful tropical storms associated with Hurricane Octave caused the most widespread damage in the recorded history of Pima County with as much as 7.5 inches of rain falling in some areas over five days, and caused more than $500 million in damage to private property.

I-19 and San Xavier Mission Rd. – 1983

1986 – The District expands FLAP to include acquiring undeveloped lands in the upper watersheds when it purchases ranch property southeast of Tucson creating the Cienega Creek Natural Preserve. The Preserve represents an important watershed management and environmental preservation effort.

1991 – Pima County enters the Community Rating System.

Camino Verde - 1990

Santa Cruz River – 1993

1993 – In January, nearly five inches of rain make this the wettest January on record, causing flood damage along Tanque Verde Creek and the Rillito. High water levels in the major watercourses did not subside for almost two weeks, and record-setting volumes of water were discharged along the Rillito Creek.

2003 – In August, the Aspen Fire in the Santa Catalina Mountains changes the hydrologic characteristics within the Cañada del Oro watershed. Subsequent rainfall resulted in flooding, erosion, and major debris flow in the community of Catalina, leading to the evacuation of some low-lying area residents. Using FEMA mitigation grant funds, the District acquires over 70 properties in the Cañada del Oro floodplain and creates the Catalina Regional Park.

2005 – The District separates from the Department of Transportation and is recognized as a stand-alone County department.

2006 – In July, rainfall totals over a five-day period reached 10 inches on Mt. Lemmon and nearly as much in parts of the Tucson area. Despite the largest flow ever recorded on Rillito Creek, property damage was minimal as a result of the District's flood control improvements over the past decades.

Tanque Verde / Agua Caliente area - 2006

Arroyo Chico – 2015

2007 – In September, Pima County experienced two large rainfall events in midtown. However, the District maintained regional detention basins on Earp Wash, Rodeo Wash, and the Kino Environmental Restoration Project, prevented these large rainfall events from becoming large flood events.

2011 – Pima County achieves a Class 5 rating in the Community Rating System.

2017 – Pima County implements it first Program for Public Information, which coordinates a flood awareness outreach program for maximum effectiveness.

2018 – Pima County commemorates the completion of The Chuck Huckelberry Loop. The Loop was born out of the District's response to past flooding by designing and constructing miles of soil cement bank protection.

PIMA COUNTY

Board of Supervisors
Ramón Valadez, *Chairman*, District 2
Sharon Bronson, *Vice Chair*,District 3
Ally Miller, District 1
Stephen W. Christy, District 4
Betty Villegas, District 5

Pima County Administrator
Chuck Huckelberry

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