Green Infrastructure
Low Impact Development
in Arid Environments

Middle Rio Grande Low Impact Developments: Projects for Storm Water Management

Third Edition

February 19, 2015

Sponsored by:

BERNALILLO COUNTY
STATE OF NEW MEXICO

SOUTHERN SANDOVAL COUNTY ARROYO FLOOD CONTROL AUTHORITY

Introduction

The goal of the Mid-Rio Grande Arid Low Impact Development projects booklet is to show what is happening in our community, to inspire ideas and to show what can be done. The ARID LID terminology is relatively new but the concept of doing the right thing with minimal impact to the surrounding environment has been in existence for a long time. The Third Edition ARID LID booklet highlights a variety of local projects with varying cost and techniques. If you have recommendations and projects for next year please contact info@sscafca.com and we will work to incorporate them. Thank you to all of the organizations, companies and entities that provided sample projects.

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Agua es Vida Student Water Conservation and Awareness Project

This 550 gallon rainwater harvesting tank was installed in May 2014 at a private residence in Albuquerque to supplement irrigation of a small fruit orchard, and pollinator/vegetable garden (seen in the background). The tank collects roof runoff from approximately 300 sq-ft of roof. The tank sits on a platform of cinderblock in order to raise it enough in elevation to use gravity to water the surrounding garden, requiring no added electricity to pump water.

Planning, design, installation, and art stencils were all done by eight high schools students from Rio Grande and South Valley Academy from Albuquerque's South Valley, with supervision from teachers and community partners of the Querencia Institute (http://www.querenciainstitute.org/), a nonprofit dedicated to improving the learning experiences of young adults in the arts and sciences of sustainability. Each student did independent research and worked with local artists to create a stencil that represented eight principles of water harvesting. This project was supported by a Toyota Together Green by Audubon grant.

As of January 2015, the tank is completely full with late fall rains. The landowner is saving this water for the spring growing season.

Contact information

- **John Wright Querencia Institute**
- **P: (505) 503-3672**
- **E: gjuanito@hotmail.com**

Albuquerque Open Space Visitor Center Green Infrastructure Demonstration Project

Contact information

- **Jodi Hedderig, Site Manager: jhedderig@cabq.gov; (505) 897---8865; cabq.gov/openspace**

This demonstration project transformed a barren, actively eroding portion of the grounds into a multi---functional showcase of watershed friendly landscaping and green infrastructure. Stormwater bio---retention basins were integrated with the existing roof water tank to provide multiple site and community scale benefits.

Rain falling on the auxiliary building is conveyed into the cistern for later use. Overflow from the cistern, surface runoff from portions of the gravel road, and direct rainfall are collected and infiltrated in the bio---retention basins, providing passive irrigation to the plantings and increasing localized soil moisture. A layer of wood chip mulch feeds soil biological activity and reduces evaporative losses. Rock aprons stabilize the inflow to the basin and overflow between basins, and can support seed germination. The project manages stormwater from approximately 1800 sq. ft. of impervious surfaces plus direct rainfall on the landscape.

Project Implementation:

- 2013: Bernalillo County Master Gardeners install roof water tank under guidance of Blair Stringam, with tank donated by NM State University
- September 2014: Rough excavation with backhoe by City of Albuquerque Parks and Recreation; Participants and instructors during Watershed Management Group's Water Harvesting Design Certification training course completed the finish grading, rock armoring of key areas, planting native and climate---adapted plants, and mulching. Primary project design and facilitation provided by Jeff Adams of Terrasophia LLC

Before

During

After

City of Albuquerque Native Plantings and Permeable Paving Installed as Borders at City Parks

City Of Albuquerque
Department Of Parks
& Recreation

During calendar year 2014, the City of Albuquerque's (COA) Parks and Recreation Department (Parks) placed 2-foot wide permeable pavers on the outer rim at 10 parks: Cardwell, Mary Fox, Ross, Valley Haven, Monroe Green, Martineztown-Santa Barbara, Onate, Aztec, Del Sol, Vail, and Eisenhower Middle School Pool. Approximately 20,000 square feet of permeable paving was installed at a cost of $24 per square foot.

Parks also put in clumps of Stipa grass edging along arroyos in the following parks: Heritage Hills, Stardust Skies, Snow, and Ross Enchanted. About 12,000 square feet of Stipa grass was planted at a cost of $22 per square foot.

The COA will monitor these areas for water savings and additional variables and will report on their findings in future reports.

For additional information please contact the City of Albuquerque Department of Parks and Recreation, http://www.cabq.gov/parksandrecreation, or the senior landscape architect, David M. Flores, at DFlores@cabq.gov.

Ambassador Edward L. Romero Park

Contact: Robert M. (Bob) Oberdorfer, RLA (Project Landscape Architect); (505) 228-1710; rmo59@msn.com
Project was designed by Resource Technology, Inc. [no longer in business] and built by Mountain West GolfScapes

When a new subdivision was planned for a former alfalfa field in Bernalillo County's South Valley, the County's Parks and Recreation staff decided the proposed park site would be a good opportunity to try to bridge the gap between the surrounding established neighborhood and the new community that was seen as something of a threat to their rural roots. Instead of being centrally located, the four-acre park was situated at the effective rear of the new development, surrounded on three sides by back yards of the new homes, but facing the older residences across its primary access road. And instead of building a traditional "swings and soccer fields" facility, the County took the opportunity to develop a showpiece of sustainability.

Romero Park Drainage Schematic

In 2002, the park site became the subject of a Graduate Design Studio for UNM's Master of Landscape Architecture program, during which three student teams spent a semester getting to know the area and its residents, developing three master plan concepts for the park, and presenting them to the community. Then in 2004 the County commissioned Resource Technology, Inc. (RTI) to combine the three disparate plans into a cohesive design that would not only keep the neighbours happy, but also respect the thought and creativity that went into the original student designs.

Bioswale lined with recycled concrete sidewalk slabs reused from nearby streetscape project

One of the greatest challenges of the project was to deal with stormwater flows. This is because the park site also serves to collect all of the surface runoff from the new subdivision in a retention capacity, meaning that there is no outfall to other storm drainage facilities. Due to its lowland setting and the lack of surrounding drainage infrastructure, the park was required to accommodate the full 100-year storm runoff volume from the surrounding development, with only emergency overflow facilities to carry anything greater to the nearby Rio Grande.

Rather than concentrating the runoff in one corner, as the original site developer had done, RTI's grading plan slowed and spread water across the site, whereby it could help to irrigate turf and native vegetation. In order to minimize site-generated runoff, the park also features the first use of permeable concrete in the Albuquerque area, in the parking stalls, as well as permeable pavers in the entry plaza.

Bioswale lined with recycled concrete sidewalk slabs reused from nearby streetscape project

Terraced bioswales, lined with recycled concrete slabs, carry runoff from the surrounding streets, allowing infiltration of low flows, while higher flows are conveyed to the lowest part of the site, which sits very close to ground water level and is now a permanent wetland. Supporting native cottonwoods, willows, and sedges, and surrounded by a native wildflower meadow, the wetland is home to songbirds and pollinators in the spring, summer and fall, and offers adventure and exploration opportunities for area children year round.

Staying faithful to the themes of early New Mexico agriculture and the Spanish-New Mexican cultural bond, thematic elements include a Moorish-style entry plaza and decorative metal panels depicting aspects of agriculture of the Middle Rio Grande Valley, as well as a circular shade structure patterned after the blades of an agricultural windmill.

Ponded stormwater spreads into native grass meadow following 1" rainfall

In addition to its water harvesting features, water conservation was a principal goal of the design. Most of the vegetation is native or drought-tolerant, and accommodations were made during design and construction to enable the irrigation system to be tied into a planned non-potable water line being implemented by the Albuquerque/Bernalillo County Water Utility Authority.

Athena Pond/Park

Contact information

- **Larry Blair, ESCAFCA, blairylar@hotmail.com**

The Mountainview subdivision in the Town of Bernalillo, NM suffered from two maladies: it had no park; and was subject to flooding. The Town acquired a 4.5 acre tract in the middle of the neighborhood and proposed that the Eastern Sandoval County Arroyo Flood Control Authority (ESCAFCA) and the Town collaborate on building a combination park and flood control facility (see "Before" photo).

A cooperative agreement was signed and Wilson & Company, Inc., Engineers & Architects (Wilson & Company) was tasked with designing the pond/park and the surrounding storm sewer collection system.

The idea was to excavate a ponding area deep enough to provide effective flood control, but also to configure the pond so it could be used as a ball field, picnic area, and small park. A tri-level design was approved, with park grass and native plantings serving a recreational purpose and also functioning as a biological filter for stormwater.

Borings revealed that the water table was only 13 feet below the surface, creating an opportunity for recharge. Wilson & Company designed a system which incorporated underground chambers situated two feet above the water table and underneath the ballfield, which filters incoming stormwater and allows it to percolate downward (see "During" photo).

The completed project (see "Completed" photo) is an eight-foot deep pond with gently sloping sides, with a volume of 11 acre-feet, and with a popular walking/jogging trail around the perimeter. It serves as a core flood control facility for present and future needs, acts as a stormwater biologic filter and groundwater recharge, and provides a much-needed neighborhood multi-use park.

Since completion in Spring 2013, the pond has intercepted two storms and performed as expected.

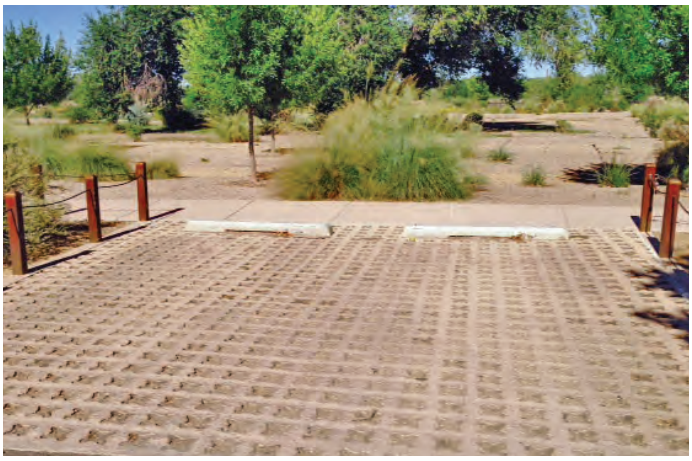
Before

During

Completed

Bachechi Open Space Park

sites southwest



Permeable Pavement

Sites Southwest worked with Bernalillo County on the master planning and design of a 27 acre parcel of land in Albuquerque's North Valley. The site is adjacent to the nation's largest cottonwood Bosque and the 20 mile long reach of the Rio Grande Valley State Park. The project showcases ecologically and environmentally appropriate techniques to help create an urban forest. This open space amenity enhances the experience of users; bicyclists, hikers, and equestrians. A master naturalists program supports environmental education in the region. The park serves as a gateway to the larger Rio Grande Valley State Park. The project also educates through an extensive system of interpretive signage and includes an Environmental Education Center used to study Rio Grande Valley habitat and ecosystems. The Education Center was designed to facilitate small classroom events, community meeting spaces and research with organizations like the University of New Mexico's Bosque Ecosystem Monitoring Project (BEMP). Water from the Education Building roof is directed to above ground cisterns and used as supplemental irrigation for the surrounding landscape as well as an educational feature.

LID Techniques Used

- **The Bachechi Project manages stormwater in natural ways that mimic the historic flow of the Rio Grande and recreates forests (Bosque) respecting the areas native plants**
- **All pavements added to the project are either permeable or lead to water harvesting zones**
- **Cisterns from buildings were used for the collection of water from rooftops for the irrigation of the landscape**
- **Drainage solutions were applied on a broad scale to restore the watersheds hydrologic functions**
- **The park serves as a community recreational resource, providing space for social interaction**

Bear Canyon Senior Center LID Conversion

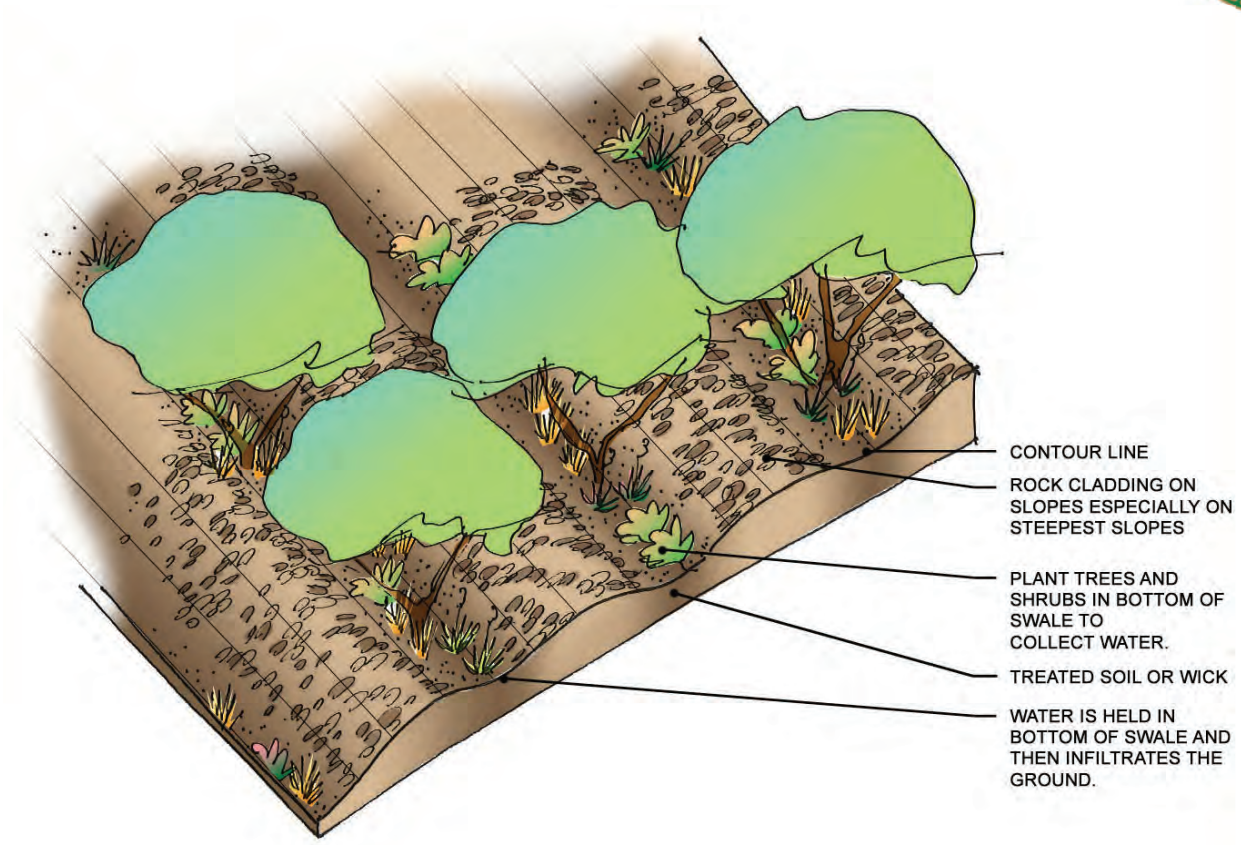
Portion Of Planted Cobble Swale At Entry

Permeable Pavers At Traffic Circle Entry

The existing 18,000 s.f. building needed a new roof, HVAC system and additional interior space. We also noted that off-site run-off from an uphill park was flooding and deteriorating the pavement serving the senior critical care facility; roof drainage was discharging directly onto the perimeter drive and into catch basins; and, approximately 5,000 s.f. of lawn and ornamental shrubs demanded excessive water and maintenance.

Working closely with the project architect we shaped the roof to direct rain water to new scuppers to serve the renovated xeric landscape. We replaced the failing traffic circle with approximately 5,900 s.f of permeable pavers and created a 175' long cobble lined swale with a series of shallow pools to help slow run-off and support on-site infiltration. The pavers are ADA accessible and now create a welcoming pedestrian access plaza to Ernie Taylor Park.

Bernalillo County Water Conservation Standards & Guidelines

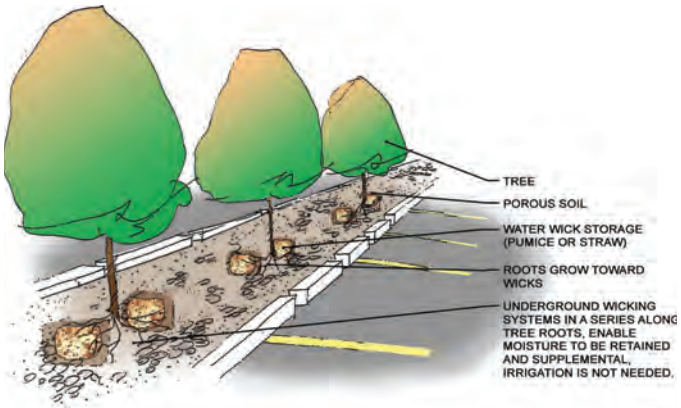


On-Contour Swales Allow Water to be used by Plants

The Albuquerque Bernalillo County Water Utility Authority (ABCWUA) estimates that between 40% and 60% of Albuquerque's drinking water is currently used for landscape and site related purposes, this figure is as alarming as it is unsustainable. Bernalillo County government realizing this contracted with Sites Southwest to develop Water Conservation Standards and Guidelines as a strategy for reducing water consumption and to achieve long-term water supply goals. The purpose of this document was to define the requirements of the County's Water Conservation Plan and Ordinance and to provide direction to developers, builders and homeowners. The goal of the project is to improve water conservation through Best Management Practices (BMP's), and increased compliance with the Ordinance by showing how to maximize water efficiency and conservation through design.

LID Techniques Used

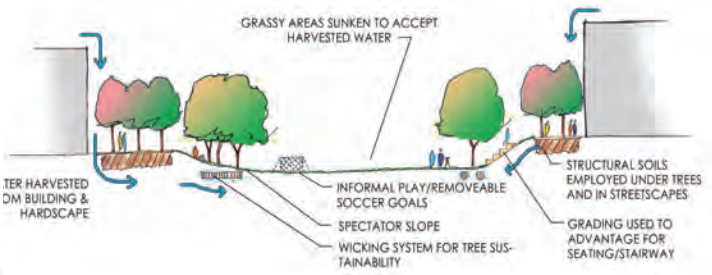
- **BMP's for Stormwater Harvesting and Bioretention**
- **Drawings to illustrate the use of vegetated roofs and cisterns**
- **Applied concepts for returning the land to its natural hydrologic function**

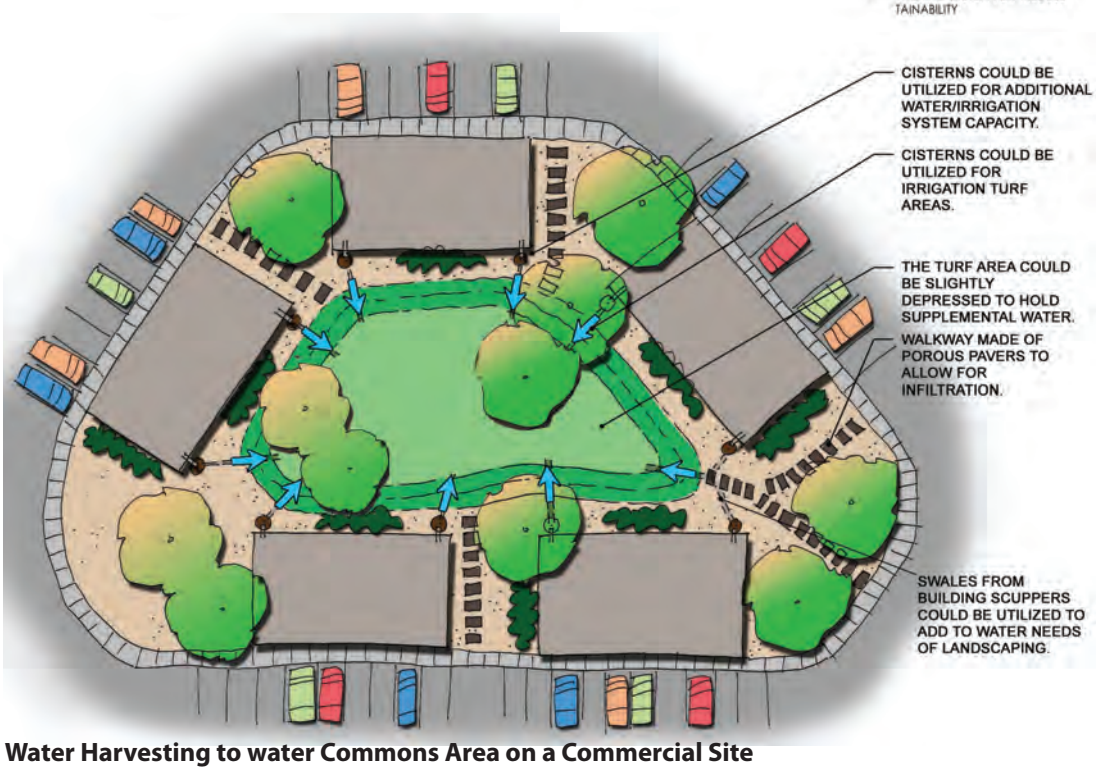


This step-by-step guidebook offers both text descriptions and diagrams to provide the tools to conserve water. It provides the direction necessary to analyze the site, design for maximum rainwater retention and minimal disturbance, and it illustrates the methodologies for water harvesting, low impact development, conservation oriented irrigation, and it includes tools such as plant lists and digital water savings calculation sheets. Methodologies explored in the document include the use of water harvesting devices, bioretention facilities, vegetated roofs and green roofs, cisterns, permeable pavements and other green infrastructure principles. A accompanying protocol document is being developed as a companion to the Standards and Guidelines to assist users in the processing of plans through County government channels. Together with the Standards and Guidelines, the Protocol Document enables both applicants and County staff to easily determine whether or not the requirements of the Water Conservation Ordinance can be met.

The Water Conservations Standards and Guidelines for Bernalillo County will provide the first document of its kind in the state and perhaps region to direct the user through the choices available to them to conserve water in an easily understood digital and hard copy format.

Simple Water Harvesting in Parking Area on a Commercial Site





Water Harvesting to water Commons Area on a Commercial Site

Big I Landscape improvements

MRWM
Morrow Reardon Wilkinson Miller, Ltd.
505-268-2266
www.mrwmla.com 210 La Veta NE
Albuquerque, NM 87108

Check dams and gabions slow runoff

Before: erosion on Big I

Detention basin

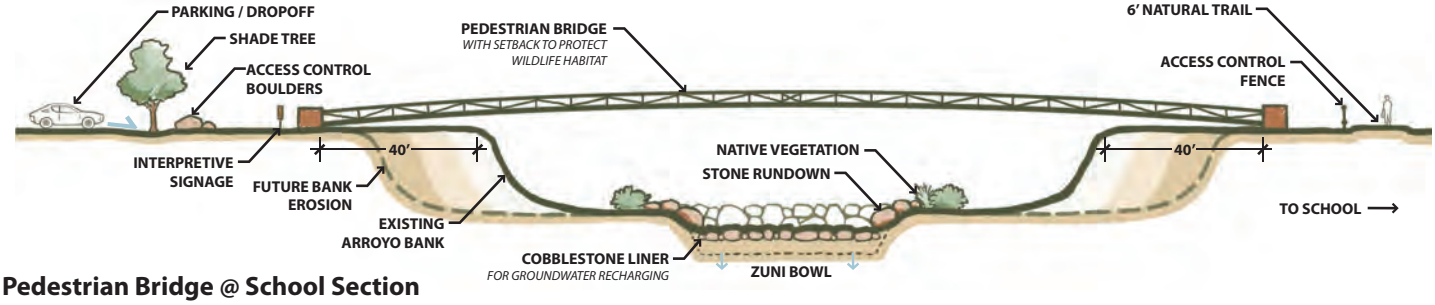
- **Erosion -** Mitigation of erosion, sediments loads, and chemical laden roadway runoff were key considerations in the landscape design
- **Solutions -** Gravel splash pads and check dams dissipate the erosive force of concentrated discharges. Rip rap lined swales remove large and small particulates while directing stormwater to detention basins. The native and naturalized planting in and around the basins provide additional filtration. Gabions, contouring, and gravel mulch stabilize the steep slopes.

Project statistics

Location:	Albuquerque at I-25 and I-40
Owner:	City of Albuquerque
Budget:	$12 million
Primary Consultant:	MRWM Landscape Architects Landscape Contractor: Mountain West Golfscapes and LeeLandscapes
Start Date:	2006
Completion:	2010

Black Arroyo Wildlife Park Master Plan

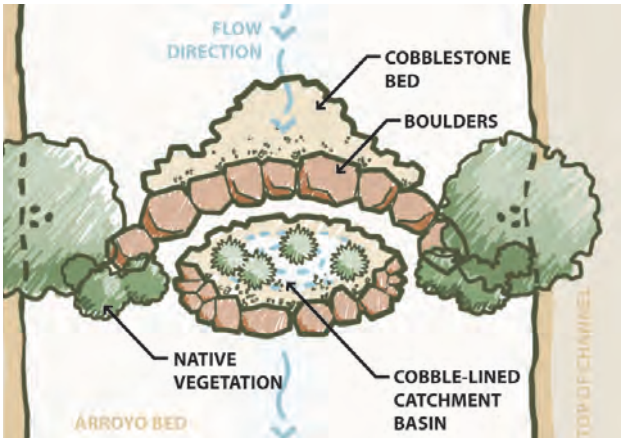
sites southwest



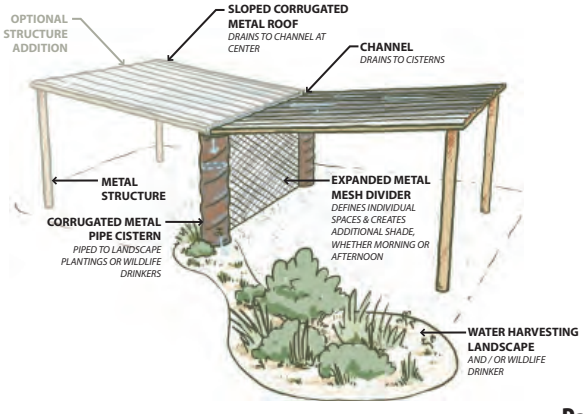
Pedestrian Bridge @ School Section

The Black Arroyo Wildlife Park s a 72 acre parcel that stretches from near the corner of Unser and Southern to Unser and Westside in Rio Rancho, New Mexico. It is owned by the Southern Sandoval County Arroyo and Flood Control Authority (SSCAFCA). Aside from its flood control needs, the Park will provide a respite and an educational venue for residents, students, workers and other visitors, one of the goals of the facility is to illustrate how drainage facilities can work in more naturalistic ways. Sites Southwest performed the Master Plan and subsequent trail plans for this Park and arroyo. The Park includes trails, trailheads, parking areas, 3 pedestrian bridges, interpretive signage, shade structures, wildlife drinkers fed through water harvesting, and furniture for users.

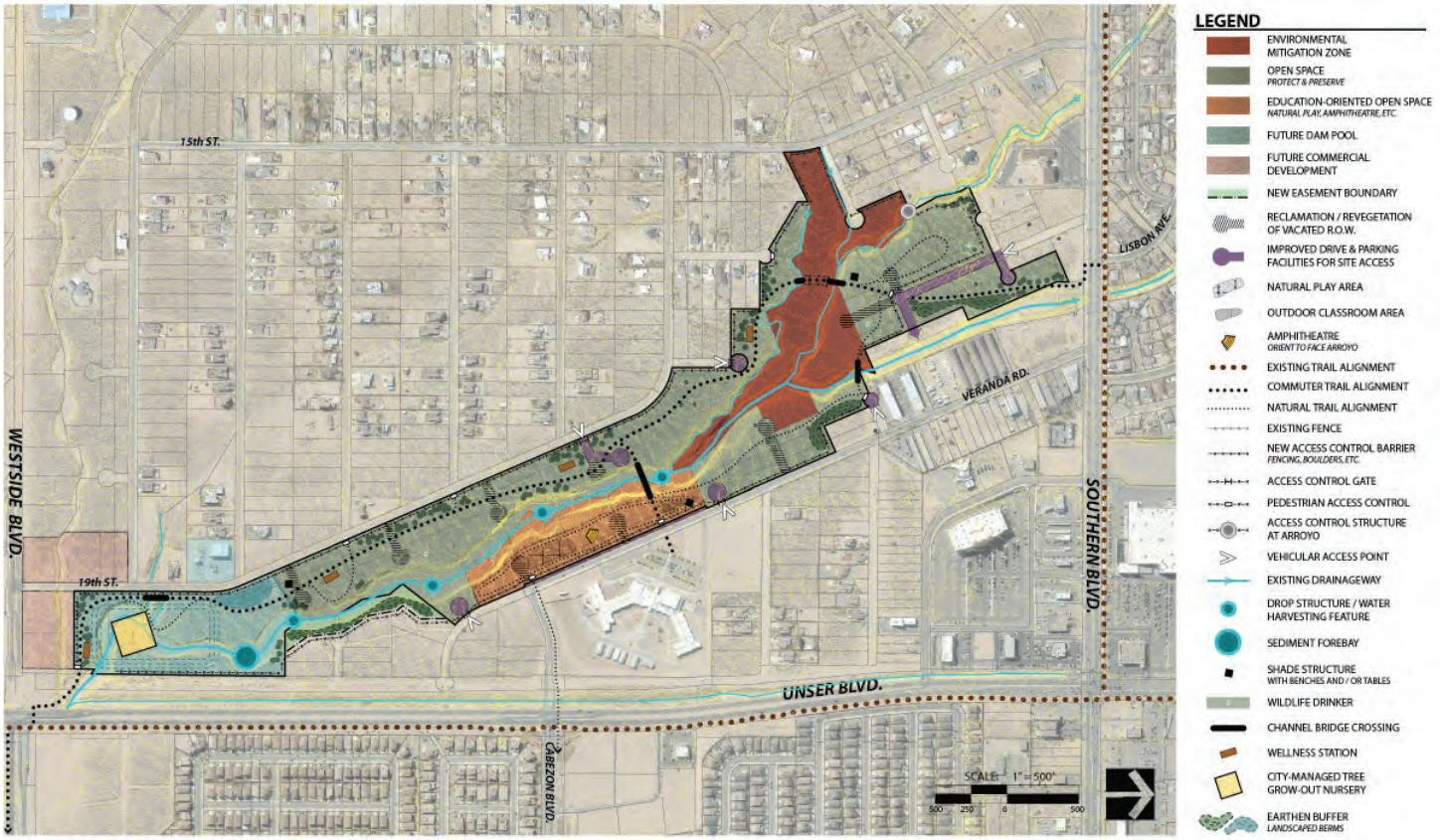
SSCAFCA's forward thinking approach to the development of this Watershed and Park demonstrates to other agencies that in the future multiple use of facilities are the only real way to plan an open space that provides a flood control function while offering passive recreational opportunities in a cost effective and functional manner. This project includes a host of LID strategies for naturalistic systems which include check dams and Zuni bowls for water collection and cleaning, use of flush water from an upstream city facility, use of berms to reduce the sediment along the trail and in arroyo tributaries, and water harvesting from parking lots/trailheads and surrounding streets to aid in revegetation.



Zuni Bowl

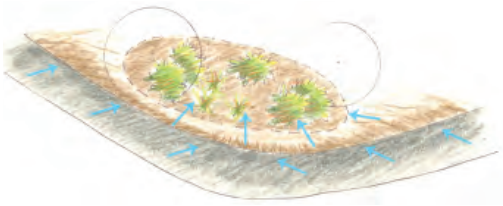


Shade Structure



BLACK ARROYO - SITE MASTER PLAN

Black Arroyo Trail Concepts Water management Sketches

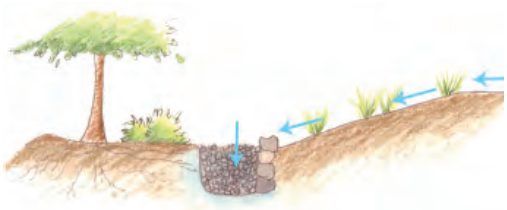


Curved Trail Basin

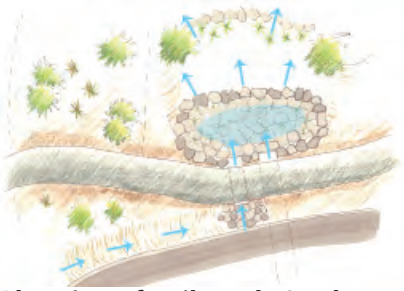
Slowing and ponding small drainages to protect trail

Rolling Dips in Trail

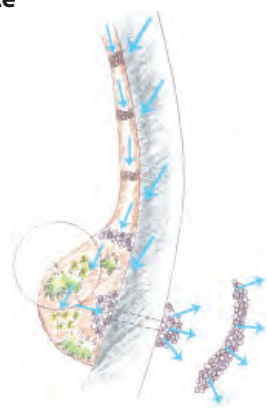
Culvert with Zuni bowl/dissipation pond device



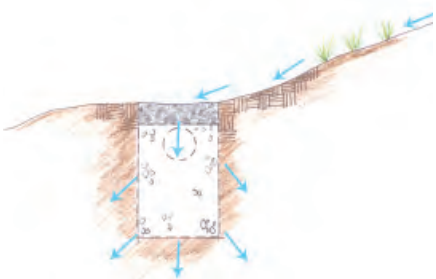
Level Spreader



Plan view of trail, swale & culverts



Swale along trail with shallow basin and overflow disbursement in plan view



Level Spreader with pipe

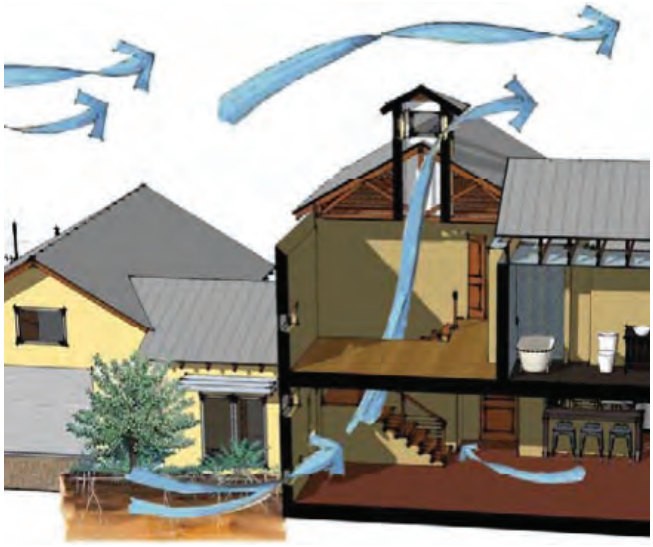
Swale along trail with shallow basin and overflow disbursement in section

Casa de KP3

Located in Albuquerque's North Valley, Casa de KP3 was designed holistically—the site, architecture, and infrastructure designed together to achieve a fully integrated project. Project goals were to reduce energy needs of the house; create multiple private outdoor areas sheltered from winds and sun; create functional microclimates; collect and store all rainwater on site, in the soil, with above ground storage for seasonal needs; create habitat; and grow food.

Features

- Earthworks are designed to capture and infiltrate rainwater; overflows moving water from basin to basin. Water is directed away from the building's foundation.
- Greywater outlets to basins. Flow splitters can be set to divide flow for equal distribution or can direct flow to specified areas as needed
- All paths and landscape surfaces are permeable
- Run-off from the adjacent gravel road is directed to trees via a river rock swale
- A 1,200 gallon rainwater cistern provides water for the food gardens. Cistern overflow is directed to basins supporting fruit trees
- Custom gutters extend above the eaves angle to prevent overflow during peak events design of the 2,700 sf home that operates at net zero
- The steep slope of the adjacent ditch bank is subtly terraced, minimizing erosion while supporting a healthy pollinator belt. Plantings will buffer wind impacts and reduce west sun exposure on the food garden while visually screening the ditch road when mature.



The house is passively cooled through coordinated win- dow placement, landscape design, and rooftop cupolas that function as passive cooling towers. Rainwater and greywater is directed into planted basins, creating a microclimate from which cool air is drawn into the house through strategically placed low windows.

Results

- All rainwater was held on site in September of 2013, when record rains exceeded 5 inches in 7 days, including run-on from adjacent areas
- The house is passively cooled through coordinated window placement, landscape design, and rooftop cupolas that function as passive cooling towers. Rainwater and greywater is directed into planted basins, creating a microclimate from which cool air is drawn into the house through strategically placed low windows.
- With the landscape serving as an integral part of the house's passive cooling system, energy use of the house is significantly reduced—a key feature in the integrated
- Wood mulch in all landscaped areas reduces water need while building healthy soil
- Basins used for both greywater and rainwater assures periodic flushing

Contact information

- **Leslie Buerk | Kalyx Studio | 505.452.9975**

El Parque del Rio

surroundings

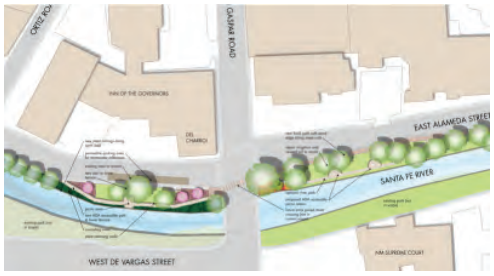
Funded through the City of Santa Fe's 2008 Parks Bond, the project scope required us to examine the parkways along the river from St. Francis to Palace Avenue.

A lowered water table has occurred over time due to the channelized river condition and has affected many of the trees along the park. Stormwater is a powerful part of urban watersheds that currently bypasses the park through traditional drop inlets. These pipes feed water and pollutants directly into the river. In order to re-hydrate the parkway and decrease pollutant loads into the river, Surroundings proposed several innovative strategies to reinvigorate water into the soil.

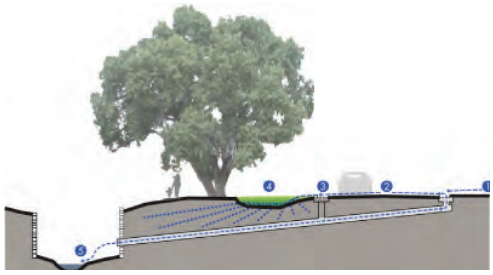
Stormwater acequias take water from the streets and sidewalks and distribute it into water absorbing wicks to benefit orchard trees and native cottonwoods. "Oxbow" swales are simple depressions created to allow water to infiltrate and in large rain events exit and continue to another swale or traditional stormwater inlet. Surroundings is also utilizing the existing stone curbing near Old Santa Fe Trail to intentionally allow "leaking" under the sidewalk and hydrate the cottonwood canopy downtown.

Concept Photomontage

Partial Schematic Vision Plan (St. Francis to Paseo)



Enlargement Plan at Don Gaspar



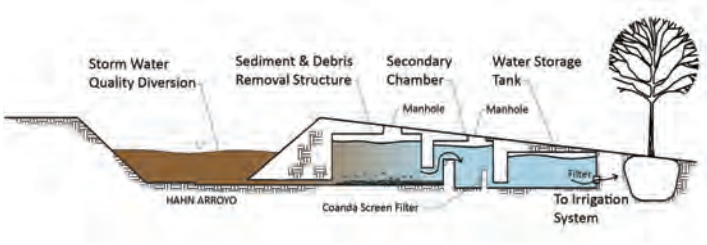
Stormwater Concept Section Diagram

Stormwater Acequia Photomontage

Hahn Arroyo Desert Parkway Landscaping Solutions

sites southwest

Photo Simulation



Cistern Section

The primary purpose of this innovative rehabilitation project is to replace the drainage channel and prevent flooding, damage to property and loss of life as well as improve water quality. The team took a "Whole Systems Approach" to the project by including storm water quality devices, water harvesting strategies, and the use of the area around the channel as open space and recreation. The design includes diversion structures that remove pollutants from stormwater and then harvest some of the water into cisterns for reuse on landscaping. The landscaping provides shade, wildlife habitat, recreational opportunities and visual relief. Another aspect of the project includes the reuse of the old concrete channel for retaining walls and plazas within the park lands. Other recreational enhancements include a multi-use trail, dog watering stations, and wayfinding signage as well as tire filling stations for bicyclists using the trails.

Sites Southwest worked closely with project engineers and AMAFCA and gained unanimous approval of the concept by the AMFACA Board of Directors after which we coordinated and conducted additional public informational meetings at which the project was well received.

LID Techniques Used

- **The Hahn creates a functional and appealing drainageway that treats stormwater as a resource**
- **The Project re-conceives the arroyo as both a stormwater conveyance and a natural landscape feature**
- **The Hahn Greenway Project integrates this drainageway into the Community**
- **The Project harvests water from the channel to create a sustainable landscape Park**
- **Extant site materials such as concrete were recycled for the use of the newly designed project**
- **Project aesthetics, recreational opportunities and site amenities create a neighborhood gathering place and add value to the adjacent residences**

Hahn Arroyo Phase I Engineering Solutions

The Hahn Arroyo – Phase I reconstruction was an opportunity to go beyond typical flood control and incorporate elements such as storm water quality, low impact development (LID), and sustainability into a flood control project. This included using recycled concrete for seating, harvesting water from the channel for irrigation, collecting surface flows for passive irrigation, cleaning storm water before it reached the Rio Grande, and creating an urban park for the enjoyment of the public.

Flood Control Components

- The flood control channel has a meandering alignment and tinted shotcrete lining to soften the effect of the flood control channel and to provide a more natural look to the arroyo
- An In-Channel Water Quality Structure to collect gross pollutants from the channel.

Water Quality and Water Harvesting Components

- In-channel system to collect well wash water and storm low flows for use in irrigating the plantings in the linear park. Not one drop of potable water is used for the irrigation of the landscaping!
- Underground cisterns to provide added cleaning and storage for the recycled irrigation water
- Installation of an underground booster station to provide final cleaning and pumping of stored water for irrigation

Pedestrian and Bicycle Amenities Components

- Paved bike path and a soft walking/running path
- Encourage pet activity by providing soft trail (unpaved), pet waste stations, and waste containers

Linear Park Features Components

- Use of recycled concrete materials in seat walls
- Landscaping meadows that include native trees, grasses and plants to create a linear park using the paths as well as habitat for wildlife
- Installed several mosaics to represent the animals found in New Mexico river environments
- Installation of bat boxes to encourage bat population for control of insects

Incorporating Public Art

- The public art component effort was led by the COA Arts Program and was titled "Rain to River". These mosaics included, dragonflies, egrets, scorpions, and fish.

The Hahn Arroyo – Phase I was designed to be a true asset to the community in many ways including water quality, water harvesting, materials re-use, public involvement, and multi-agency participation in both design and funding. During site visits, the Team routinely hears "Great project!" from bicyclists and pedestrians that use the trails along the arroyo.

Lomas – Tramway Library
Water Harvest Swale

Planted Infiltration Swale

Existing Compacted Lawn Area

Setting Boulders And Native Plants

Roof water from the library combined with irrigation run-off on a sloping compacted lawn was crossing the sidewalk and ending up in the street. The library was getting fined for wasting water several times a year and the costs were unsustainable. The existing lawn was difficult to maintain, provided little habitat opportunity or visual interest to the local residential neighborhood.

The exposed west facing slope demanded a more xeric response and planting palette. Lawn zones were replaced with high efficiency bubblers. To capture the run-off we introduced a cross slope swale 15" deep X 65' long and filled it with varying sized cobbles. Large feature boulders were placed to delineate the swale and the slope to help create microclimates for drought tolerant plantings.

Phase 2 will remove another 3,000 s.f of lawn from the east side landscape and the parking lots.

Lomitas Negras Arroyo Water Quality Improvement - Phase I

Designed by: Smith Engineering Company – Construction plans completed in February 2014 Authorized and Funded by: Southern Sandoval County Arroyo Flood Control Authority Construction Cost: 1.4 million dollars

Built by: Salls Brothers Construction Inc. – Began March 2014, completed May 2014 (completed on budget and on time)

Location: Rio Rancho NM near NM 528 and NM 448 (Corrales Road)

Problem: Large sediment loads from the Lomitas Negras Arroyo stormwater runoff events deposit in the Harvey Jones Channel (HJC) and have caused repeated channel overtopping in the Village of Corrales.

Project Purpose: Design and construct facilities that precipitate sediment from stormwater runoff thereby improving stormwater quality.

Project Description and Water Quality Data: The project began with hydraulic analysis of the 2000 ft arroyo reach. Four large grade control structures were designed and built with soil cement (cement combined with existing on site soils – a "green" solution). All structures were designed to provide stormwater retention / detention and sediment storage areas between structures. Reduced water velocities and depressed storage areas cause sediment deposition.

The photograph to the right illustrates the sediment and water storage upstream of Structures 2 and 3 after a small storm in July 2014. The upper 3 structures will retain most sediment from small storms (1 to 2 –year storms) and significant sediment in larger storms. Sediment loads in excess of these structure capacities are deposited between Structure 1 and the Dulcelina Curtis Channel (DCC) inlet.

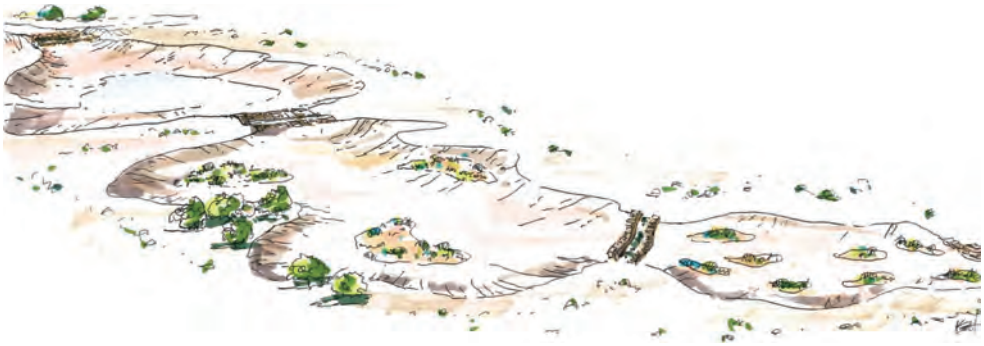
The 100-year storm hydrograph sediment volume is estimated at 18 ac-ft. The total storage capacity of Structures 1, 2 and 3 is 9 ac-ft and the storage capacity between Structure 1 and the DCC inlet is 22 ac-ft (top right of photograph below). Total sediment storage volume provided by all structures is 31 ac-ft and that provides an additional 13 ac-ft volume beyond the 100-year storm sediment volume.

Project Summary: This is a stormwater management project that provides great stormwater quality improvement. The four grade control structures (built with on-site soils – a green solution) provide stormwater runoff retention and detention to manage sediment from small and large storm runoff events.

Contact information

- **Patrick Stovall, PE (505) 314-5567 pats@smithengineering.pro**
- **Jared Lujan, PE (505) 314-5577 jaredl@smithengineering.pro**

Lower Montoyas Water Quality Feature Project



Contact information
- **Dave Gatterman, SSCAFCA, dgatterman@sscafca.com**

This innovative project, led by the Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA), is funded by the Clean Water State Revolving Fund which is Environmental Protection Agency (EPA) based federal funds. The project site is located between NM 528 and the inlet to the Harvey Jones Channel in Corrales, New Mexico. The project is designed by Wilson & Company, Inc., Engineers & Architects and is currently being bid for construction to start in March 2015 with scheduled completion by July 2015.

The objective of this water quality feature is to remove up to 65,000 cubic yards of sediment and suspended solids from storm water run off upstream of the inlet to the concrete lined Harvey Jones Channel. This sediment removal feature will protect down stream facilities from damage due to sediment deposition and improve water quality of the discharge to the Rio Grande. The design for the construction of the feature incorporates "green components" using Arid Low Impact Development (LID) techniques providing sediment and gross debris removal upstream of the channel inlet. Hardened components of the water quality feature incorporate naturalistic features as functional parts of individual components.

The hardened components consist of one water quality structure and two drop structures which will be constructed using grouted boulders, faux grouted boulders, and shotcrete. An additional drop structure will be included using dumped riprap. All structures incorporate plantings to help remove pollutants and gross debris, as will landscaped oxbows and a water quality pond. Grouted boulder backwater structures will be installed which are intended to provide the oxbow areas with periodic flooding during monsoon season replicating natural occurrences, while providing water for vegetation. Features of the project include:

- **An ARID LID project that meets safety and environmental needs in the community.**
- **Assists in allowing sediment to settle prior to reaching the Corrales Road crossing of the Harvey Jones Channel.**
- **Provides flood control and safety.**
- **Uses WaterSMART and LID concepts from a local development perspective on a regional scale to provide a functional flood control facility that enhances the environment.**
- **Keeps the arroyo channel in a natural state with minimal traditional hardened elements.**
- **Allows natural infiltration of storm flows to assist in recharging our aquifers.**
- **Promotes the growth of local native vegetation and preserve habitat for local wildlife.**
- **Plants will be an integral part of water quality and grade control structures to add a "living screen" to assist in removing debris from storm water before it enters the hard lined Harvey Jones Channel.**
- **Plants will be irrigated with reclaimed wastewater from the City of Rio Rancho.**
- **Provides a community open space asset with pedestrian trails**

Madrid Low Impact Development

Project Information:
- **Cost: $570,000**
- **Size: approximately five acres**
- **Completed: October 2014**

AGENCY: New Mexico Abandoned Mine Land (AML) Program, New Mexico Energy, Minerals and Natural Resources Department

CONSULTANTS: Rangeland Hands, Riverbend Engineering, Dekker/Perich/Sabatini

Madrid Erosion Control Maintenance Project, Madrid, NM

From 2009 to 2011 D/P/S developed a community-based plan for stormwater mitigation in Madrid, NM for the AML Program. The project, called the Madrid Mining Landscape, generated broad community support and included a comprehensive plan to improve the steep hillsides surrounding the town that had been disturbed by historic coal mining. The Madrid community saw stormwater as a resource, not a nuisance. As a result of their input, the plan included low impact development techniques such as water harvesting and slope stabilization with local materials to support landscape and watershed restoration, and make use of stormwater for community use on gardens and orchards.

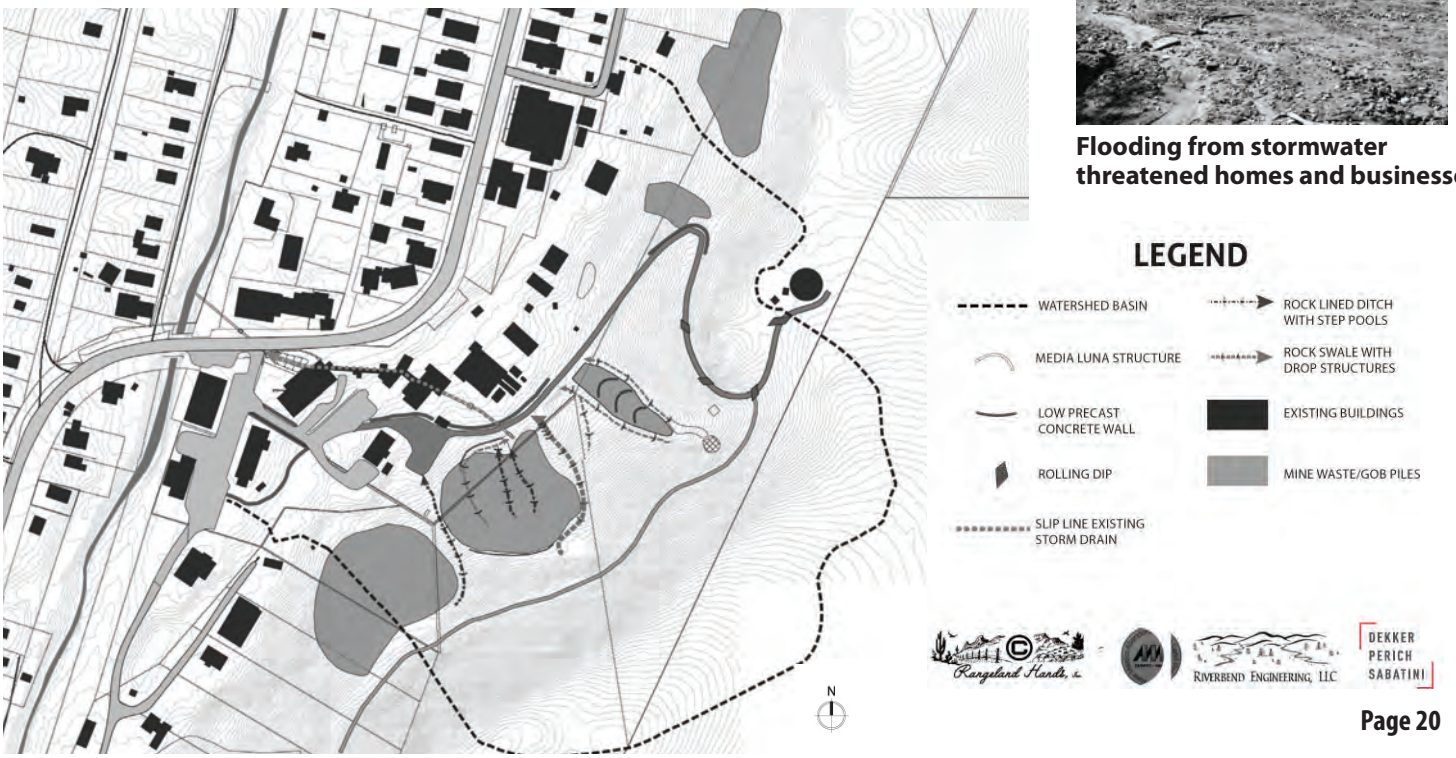
Phase I In September 2012, before the Madrid Mining Landscape plan could be implemented, heavy summer storms destabilized coal waste piles and flooded Madrid with sediment-laden stormwater. In the first phase of the Madrid Erosion Control Maintenance Project, slopes were stabilized and archaeological resources and property were protected from flooding and sedimentation. In accordance with the Madrid Mining Landscape plan, construction materials matched the historic nature of the mining district. Landscape reconstruction techniques included geomorphic reclamation with features such as Zuni bowls, step pools, rock lined swales, and media lunas. Additional stormwater mitigation work on sediment-contributing driveways included installation of rolling dips, rock lined swales, and concrete barriers to reduce erosion and channel water away from coal waste piles.

Prospective development Future projects will further mitigate sedimentation and erosion on the east slope and help restore the hydrologic function of Madrid Gulch. Projects will include sliplining an open drain that goes under the historic Mine Shaft Tavern—safely conveying water through the town and delivering it to Madrid Gulch.

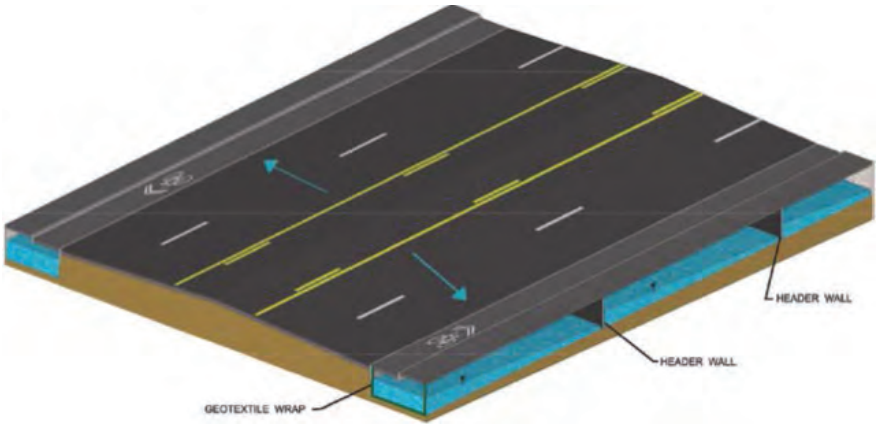
Installation of a rock-lined ditch with step pools, mitigates stormwater flooding.

An archeological site is monitored during construction.

Flooding from stormwater threatened homes and businesses.



NM 47 Peralta



The New Mexico Department of Transportation (NMDOT) is currently in the design phase of State Road 47 (NM 47) in Peralta. This project consists of a 1.8 mile stretch of total reconstruction with improvements that will create an urban section with bike lanes, curb and sidewalk. This project has been studied by various consultant engineers over the past decade and as a result multiple drainage solutions have been proposed. The drainage solution that will be used for this project is pervious concrete pavement.

Pervious concrete pavement is a relatively new drainage solution that is being used more and more to meet US EPA stormwater regulations. The application of pervious concrete pavement on NM 47 is not directly related to EPA stormwater regulations but to the project constraints of a shallow water table and the community's resistance to large retention ponds.

Pervious concrete pavement is concrete that contains little to no fine aggregate which creates a significant void content. The amounts of water and cementitious material are carefully controlled to create a paste that coats and binds the aggregate together. This creates a highly permeable system of interconnected voids that drains quickly. The voids achieved by hardened concrete are 15% to 25%. Under the concrete is open graded base course with a porosity of 30% to 40%. Between the base course and in-situ soils a geo-textile fabric is installed to prevent the base course from becoming inundated with sediment and will help maintain the intended infiltration rates. Storm water flows through the concrete and base course and is infiltrated into the natural soil.

Although this project area has yet to be permitted under EPA's MS4 coverage, this LID product poses a solution for a real world drainage issue. Upon its acceptance of meeting drainage performance requirements and maintenance standards, this may be used in many more roadway projects where MS4 obligations need to be met. More specifically it meets the MS4 requirements of capturing the 90th percentile storm and addressing water quality.

Open Space Visitors Center Permeable Driveway

Completed Driveway

Existing Surface Condition

Setting Permeable Pavers On Prepared Subbase

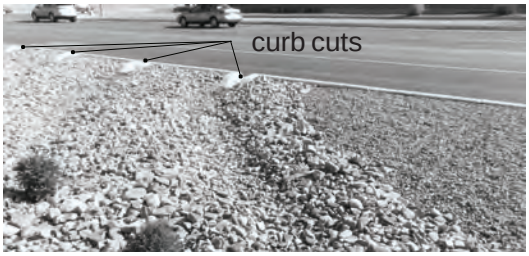
The existing gravel entry drive at the Open Space Visitors Center was no longer functioning as intended. The drive was rutted, replacing gravel was an ongoing maintenance cost, and the gravel crusher fines were being blown into an adjacent constructed wetland filling it with sediment and impacting riparian habitat.

Using an open celled concrete masonry unit we rebuilt the subbase with graded gravel on a sand setting bed and filled the cells with No. 9 aggregate to increase their strength and allow for rainwater infiltration, storage and eventual infiltration. The custom colored pavers blend into the landscape and provide a durable access that carries 3,000 vehicles per year, including trash and maintenance trucks. Blowing dust has been controlled, maintenance has been minimized and the dimpled paver surface helps reduce traffic speeds..

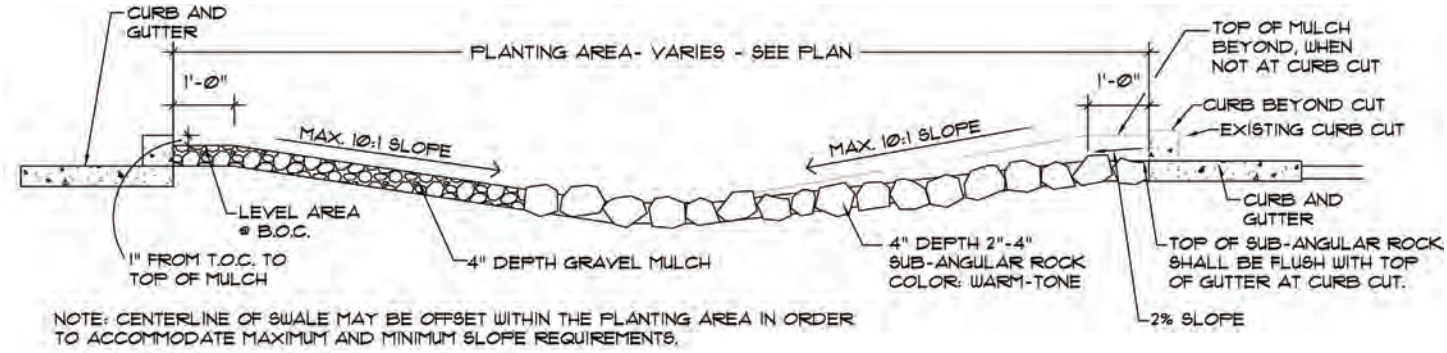
Prototype Median Landscapes

MRWM
Morrow Reardon Wilkinson Miller, Ltd.
505-268-2266
www.mrwmla.com 210 La Veta NE
Albuquerque, NM 87108

Louisiana Boulevard NE



Southern Boulevard SE



Water harvesting swale at curb cut - section across median

- **Streetscape improvements** - The City of Albuquerque implemented this project to "finish its streets" and improve the image of Albuquerque with median landscaping, without wasting precious water in our arid climate.
- **Solutions -** A swale is constructed along the length of the median to capture water and keep it within the planted area. On select medians, curb cuts allow water to enter the bioswale in the median to supplement the irrigation for the native and adapted plants. Water is slowed and soaked into the soil rather than running down the streets. Gravel and plants clean the water before it soaks into the subgrade, thus beautifying the street and providing tangible benefits.

  In the future, the amount of water entering a median through a curb cut will be monitored to determine if plants near curb cuts are receiving a significant amount of additional water. If so, these plants may be put on a separate irrigation valve, thereby reducing water consumption.

Project statistics

Location:	throughout City
Owner:	City of Albuquerque
Budget:	$2,500,000/year
Primary Consultant:	MRWM Landscape Architects
Landscape Contractor:	Various
Start Date:	2004
Completion:	ongoing

Radcliff - Residential LID

The gardens of this private residence in the northeast heights of Albuquerque are a series of outdoor living spaces joined by an 8ft. wide corridor between the home and the zero lot line neighboring home. More than 1000 gallons of water per inch of rainfall drains into this space. This offers an opportunity to resolve a drainage problem and green the passageway with rainwater.

The goal was to maintain an all-weather traffic flow: primary access for pets and the route to trash and recycling bins and, during heavy downpours, to prevent storm water from pooling and backing up into the kitchen through sliding glass doors.

The space limits options for an above ground cistern of useful capacity and the homeowner preferred a low tech solution to the drainage problem. A trench 52 ft. long 1 ft. wide and 30 in. deep was dug down the middle of the corridor and backfilled with recycled broken cinderblocks and oversized gravel, covered with geotextile filter fabric. Flagstone pavers and fine gravel mulch pave the pathways and a small patio adjacent to the kitchen door. Any excess surface water flows toward the backyard while xeric plants on both sides of the path use the rainwater when available.

Designed by Judith Phillips/Design Oasis
www.judithphillipsdesignoasis.com

Roskos Field Haynes Park Retrofit

The Roskos Field demonstration project was originally established in 2001 as a wetlands stormwater quality feature. Over time the wetlands environment was displaced by invasive species requiring supplemental fresh water. In 2013, a decision was made to rehabilitate the area and re-purpose it into an Arid environment Low Impact Development (ARID LID) demonstration garden with water harvesting elements.

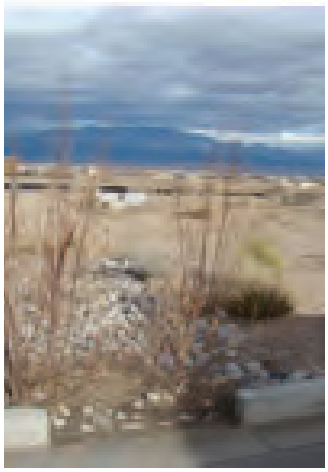
This arid garden with native plants will also provide an uptake of street toxins by the plants in a similar manner to the original wetlands without using as much water. The back pillars of the shade structure are cisterns that capture the rain water from the top of the shade structure. The rain garden has incorporated traditional water management practices for plant irrigation, along with rain barrels and directed sheet flow from harden or paved areas in the park.

The topography of the pond was reshaped into swales for runoff water harvesting. Swales are depressed sections of land, designed to slow and capture runoff by spreading it horizontally across the landscape, facilitating runoff infiltration into the soil.

The demonstration garden system highlights opportunities for individuals to incorporate ARID LID in their yards along with continuing to provide stormwater treatment on a regional level.

SSCAFCA Office Building

The Southern Sandoval County Arroyo Flood Control Authority (SSCAFCA) building was dedicated in 2010 as a LEED platinum certified facility. The building gave SSCAFCA the opportunity to demonstrate in practice the principles of the organizations mission, and adhere to: developing in ways that prudently manage water and other resources, a design that enhances the quality of the experience of using the building, and to provide a living laboratory to show the public by example both in the building and the facilities around the building. At the time, no other public building in the state used as many sustainable features within the building or incorporated such efficient water harvesting in the design. The landscaping and parking areas were designed to incorporate and demonstrate wise water stewardship as well as runoff control for land stewardship. Permeable paving in a portion of the parking lot helps reduce runoff. This allows infiltration of water instead of run off leaving the site. Along with onsite ponds and curb cuts to direct water. About 75% of the water from the building's roof is directed into a 4,800 gallon cistern for later reuse in landscape areas. Water runoff from the building not captured in the cistern is directed through the landscaping in order to reduce the storm retention system. The parking lots also allow rain fall to flow into depressed landscaping to keep the water on lot and infiltrate into the soils. Photovoltaic panel support the energy efficiency of the building by offsetting energy consumption and selling back to the grid. The office is located at 1041 Commercial Drive. SE, Rio Rancho, NM 87124. Call (505)892-7246 (RAIN) to schedule a tour Monday-Friday.



Stephens - Residential LID

The challenge in landscaping this site in the foothills in Albuquerque was the 30 ft drop in elevation from the back of the site to the street. Architects Stephen Dent and Richard Nordhaus harvested the surface soil and granite boulders for reuse and captured approximately half the roof runoff in a 1000 gal tank, an architectural feature visible from the street.

One of the owner's goals was to integrate the new construction into the hillside and revegetate primarily with locally native plants to create a resilient landscape, terraced with the stockpiled boulders and mulched with the salvage decomposed granite. Besides stabilizing the soil, the boulders act as condensation collectors harvesting any moisture in the air for adjacent plants, and the wildflower and native grass seeds in the mulch provide visual as well as ecological continuity with the adjacent City Open Space upslope to the east.

Rainwater from half of the roof drains through gutters along the north side of the home where the slope is retained with gabions and planted with dwarf cutleaf sumac to further stabilize the soil. Gabions are used wherever the potential flow of stormwater could cause erosion.

Drip irrigation from the cistern is used to water plants on the west-facing slope. The landscape is seasonally vibrant with flowering plants, succulents and evergreen shrubs providing habitat for wildlife.

Designed by Judith Phillips/Design Oasis and installed by WaterWise Landscapes Inc
www.judithphillipsdesignoasis.com www.waterwiselandscapesnm.com

UNM Education Building

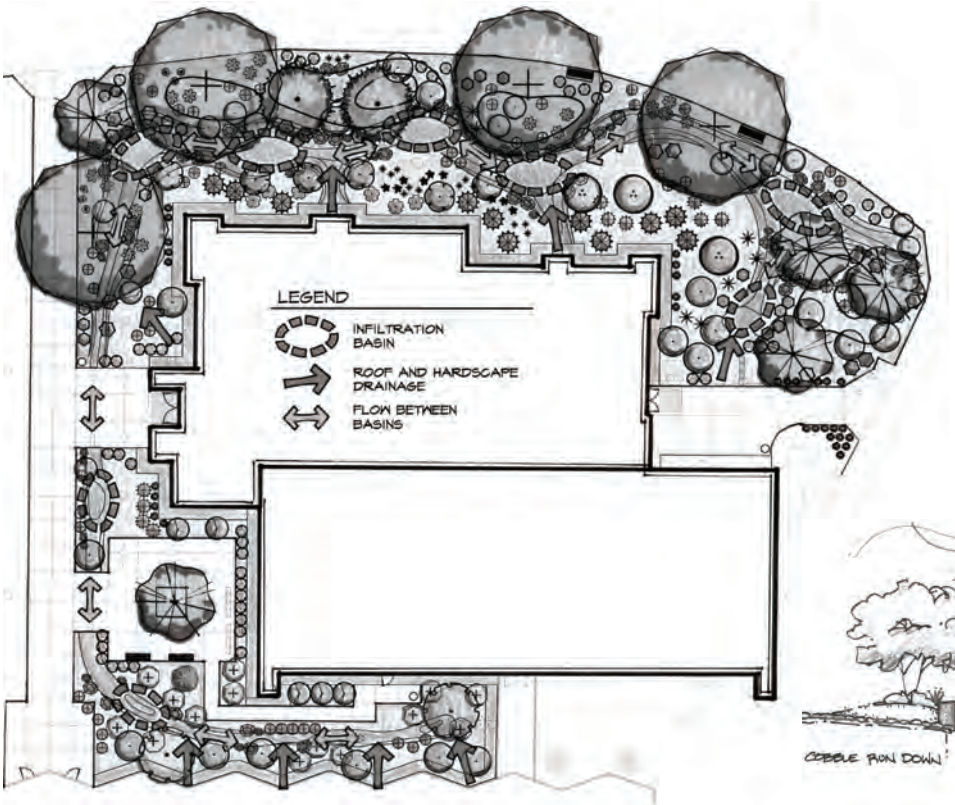
UNM's first LEED platinum building

MRWM
Morrow Reardon Wilkinson Miller, Ltd.
505-268-2266
www.mrwmla.com 210 La Veta NE
Albuquerque, NM 87108

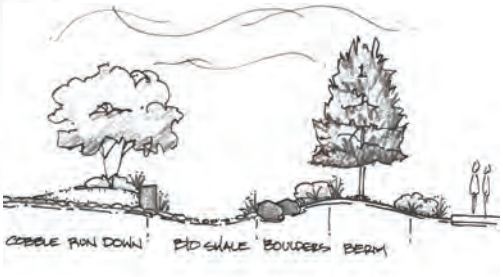
Drainage swale with plantings

Project statistics

Location:	University of New Mexico Main Campus
Owner:	University of New Mexico
Budget:	$150,000
Primary Consultant:	Gregory T. Hicks and Assoc., P.C. Architects and Planners
Landscape Contractor:	Hilltop Landscape Architects and Contractors
Start Date:	2008
Completion:	2010



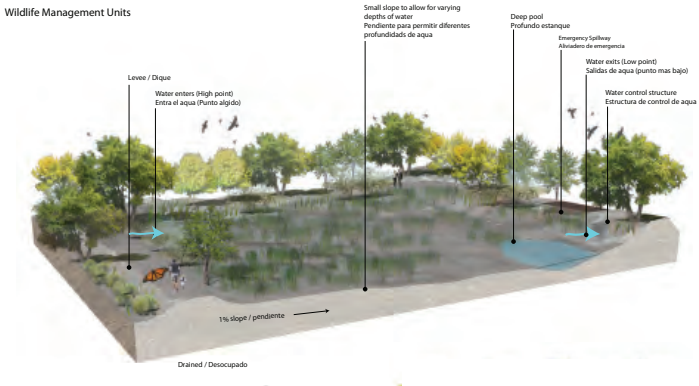
Landscape and stormwater management plan



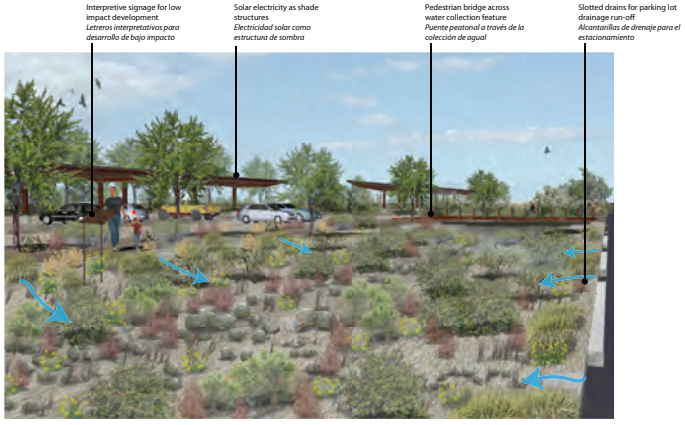
Drainage swale section

- **Urban campus** - The College of Education Building is a LEED Platinum rated project, integrating sustainable solutions into the structure and landscape.
- **Solutions -** The landscape incorporated a series of small basins linked by a shallow swale system. These features allow runoff from the roof and adjacent paved surfaces to infiltrate, providing supplemental water to adjacent plantings. This system also dissipates the erosive force of the stormwater and filters sediments.

Valle de Oro National Wildlife Refuge



Wildlife Management Units



Parking Area Perspective

Sites Southwest and Wilson and Company were selected by AMAFCA and the USFW to create a Master Plan and 30% plans for what will be the nation's first planned Urban Wildlife Refuge located in Albuquerque's south valley. This project was planned for sustainability and resilience from the start, all precipitation will be guided to created ecosystems for wildlife and wildlife viewing. This includes parking lots draining to bioswales, created "arroyos" harvesting water to help develop more densely vegetated habitats and a visitors center planned with solar collectors and cisterns for irrigation and constructed wetlands for sewerage treatment. The largest LID system at the refuge will be a swale 300' wide and 900' long which will collect water to naturally create a Bosque-like ecosystem and cleanse it through coyote willow screens and weirs with de-sedimentation areas.

Swale Concept

Section of perimeter trail

Swale Section

Waterwise Landscape Inc. - Office

When Waterwise Landscapes Incorporated remodeled its office in 2012, we worked with our remodeling contractor Modulus Design to direct most of the roof's surface to one channel and into the single above ground cistern we installed. With 1" of rainfall our 3000+ square foot roof surface collects enough water to fill our 1800 gallon cistern. Waterwise designed and installed a xeric landscape with a drip irrigation system including automatic valves and an irrigation controller to carefully use this captured rainwater. The landscape thrives exclusively on this rainwater system without any use of potable water. Overflow from the cistern and the remaining small roof surface are channeled into a french drain system that helps with infiltration as well as supplementing the landscape plants. Finally an added bonus is the system's architectural design- the open channel provides a visual aesthetic of watching water pour into the cistern during rain or snow melt.

LID Techniques Used

- **Most of the roof is channeled into an above ground cistern for use in the landscape.**
- **The 1800 gallon above ground cistern is combined with an automated drip system to use this captured rainwater to meet all the xeric landscapes watering needs.**
- **The rainwater overflow from the cistern and the remaining roof surfaces collect in a french drain that eliminates most runoff, helps with water infiltration and supplements the landscapes watering.**

Woven Plains

surroundings

Our primary challenge of this north side residence was to create a sense of privacy and enclosure, while also maintaining expansive views of the surrounding mountain ranges. The area's endless pinon and juniper landscape was permeated by undesirable public views, which left our clients feeling vulnerable. By analyzing viewsheds and views from each room in the house, Surroundings utilized walls, earth massing, and plantings that masked undesirable views while framing beautiful mountain views to the east and west. Strategically placed pinon trees obstruct lines of sight from the public street and surrounding homes.

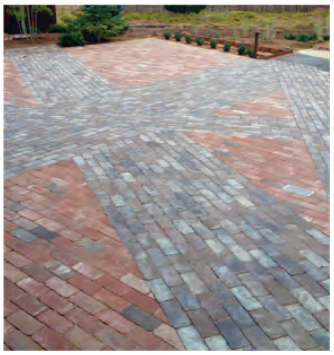
Cistern/Garden

Inspired by the client's affection for rustic antiques, we wove elements of farm and ranch throughout the landscape, juxtaposing features of old world with contemporary design. Woven bands of traditional brick blend with solar pavers and modern weathered steel walls. Raised steel vegetable beds and a metal cistern outside the kitchen call to an agricultural theme and bands of yucca along the road are inspired by old world agave plantations.

Master Plan

Mound and Wall

Careful consideration was given to the movement and collection of water on the site. A cistern captures almost half of the home's roof runoff and stores it for use in raised vegetable planters. Overflow from the cistern and runoff from the driveway flow down an acequia toward the aspen grove. A drainage system below the brick terrace collects additional roof runoff from the grand terrace and supplies it to underground scoria wicks that hold rainwater for the aspen grove.



Woven Brick Terrace

Stormwater Acequia

Sponsors

Special thanks to the Xeriscape Council of New Mexico for their assistance in pulling this booklet together.