



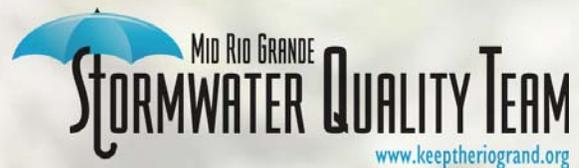
**Green Infrastructure
Low Impact Development
in Arid Environments**

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

Second Edition

February 17, 2014

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Introduction

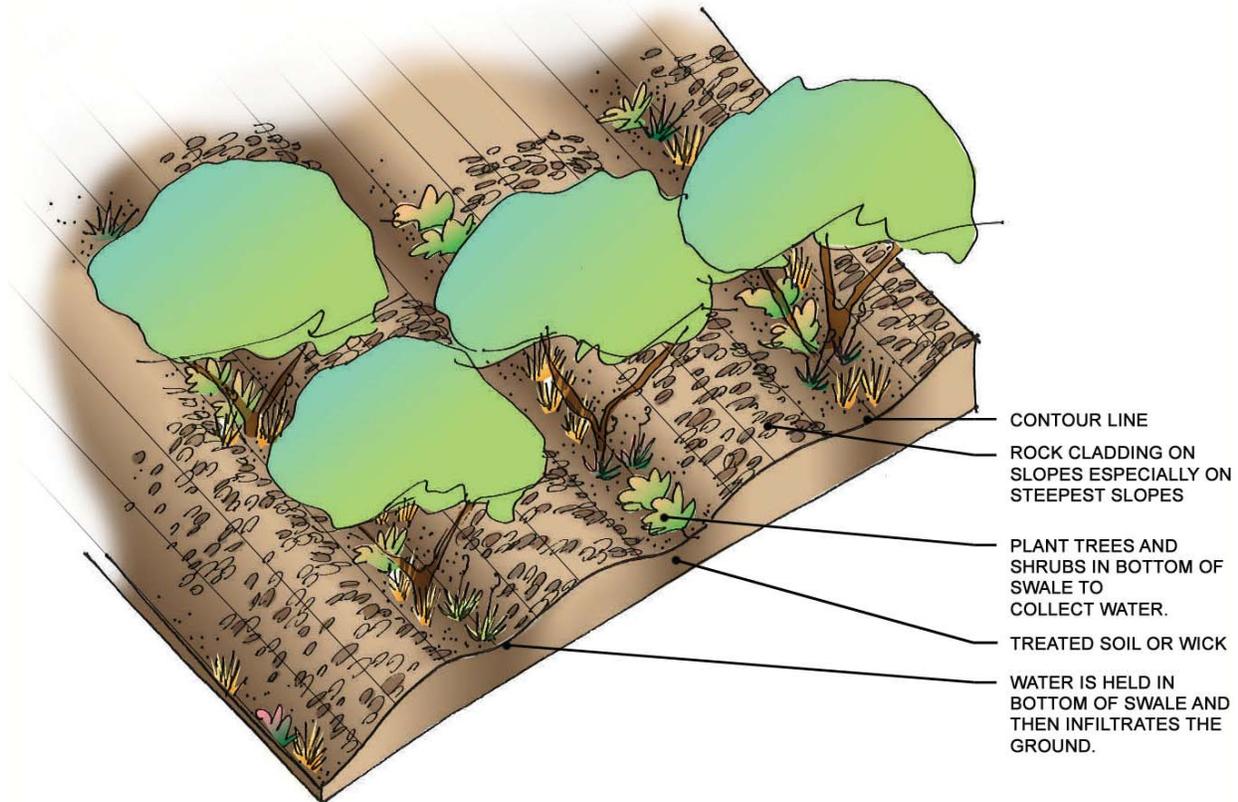
The goal of the Mid-Rio Grande Arid Low Impact Development projects booklet is to show what is happening in our community, to inspire ideas and to show what can be done. The ARID LID terminology is relatively new but the concept of doing the right thing with minimal impact to the surrounding environment has been in existence for a long time. The 2014 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.

This is the second publication of low impact development sites in the middle Rio Grande. The first publication was *Stormwater Low-Impact Development Sites in the Albuquerque Metro Area* published by Leslie Consulting, LLC.

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Bernalillo County Water Conservation Standards & Guidelines

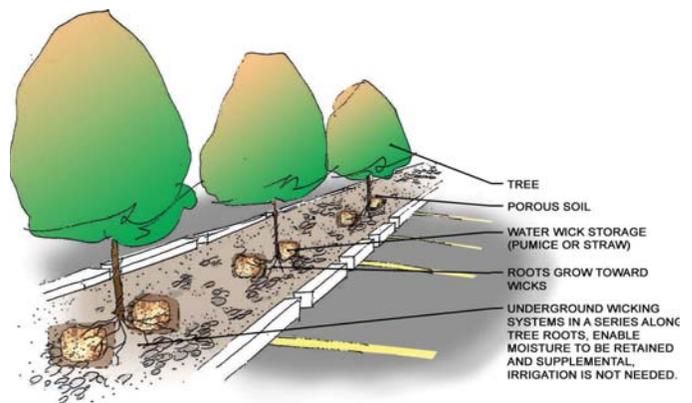


On-Contour Swales Allow Water to be used by Plants

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.

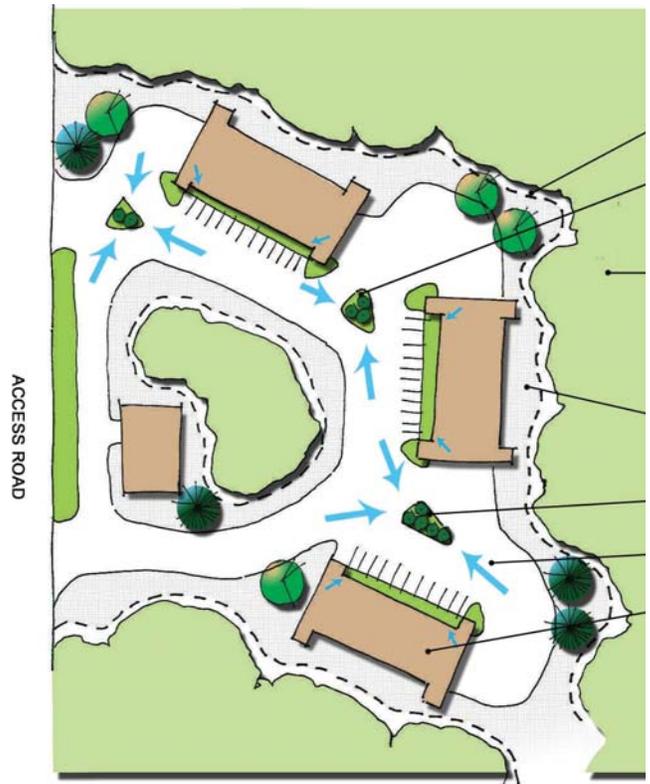
LID Techniques Used

- **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**

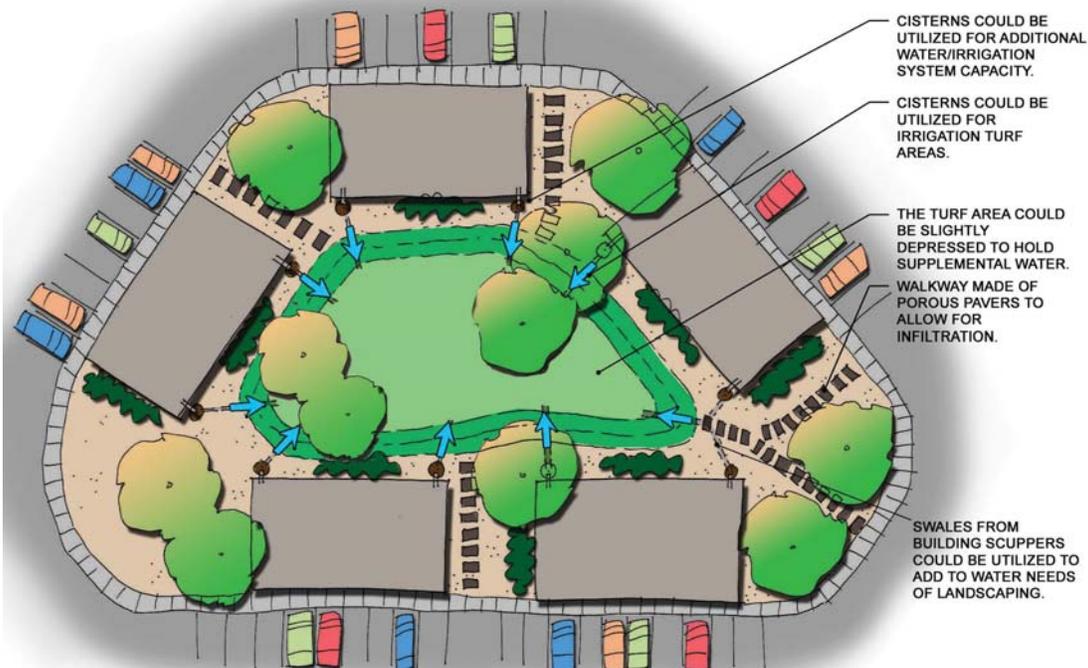
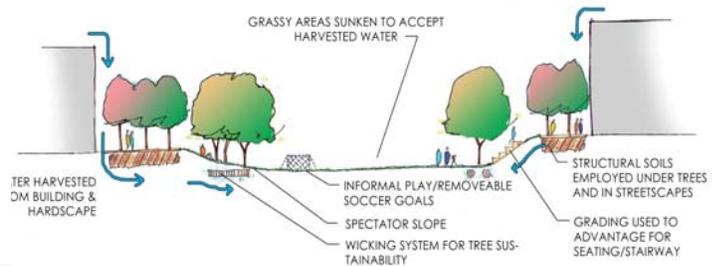


This step-by-step guidebook offers both text descriptions and diagrams to provide the tools to conserve water. It provides the direction necessary to analyze the site, design for maximum rainwater retention and minimal disturbance, and it illustrates the methodologies for water harvesting, low impact 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

Bachechi Open Space Park



Permeable Pavement



Water Harvesting Scheme and Outdoor Learning

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



Existing Conditions Prior To Design



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.

Desert Fountain

design by
Basia Irland



Desert Fountain



Desert Fountain



Stormwater Catchment System on the Roof of the Museum

Desert Fountain is an ephemeral, gravity-fed fountain designed by Basia Irland in 1998 that makes use of rainwater when it is available. Water from a portion of the museum roof is captured in a cattle tank and slowly dispenses through the fountain for several hours following a rain event. After traversing the fountain, the water drains to the museum landscape.

Basia Irland is a sculptor and installation artist, a poet and book artist, and an activist in water issues. She is a Professor Emerita, Department of Art and Art History, University of New Mexico, where she established the Arts and Ecology Program. She has also created rainwater gardens at University of Mexico and the Pueblo of Isleta. Basia's international water projects can be found in her book, *Water Library*, University of New Mexico Press, 2007. For more information about the artist visit <http://www.basairland.com/bio/>.

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.

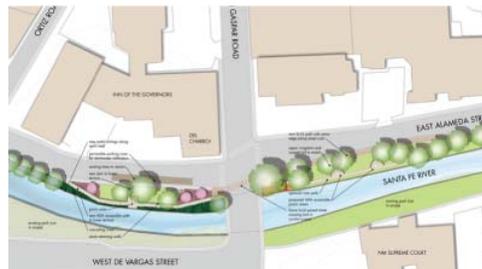
Stormwater acequias take water from the streets and sidewalks and distribute it into water absorbing wicks to benefit orchard trees and native cottonwoods. "Oxbow" swales are simple depressions created to allow water to infiltrate and in large rain events exit and continue to another swale or traditional 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.



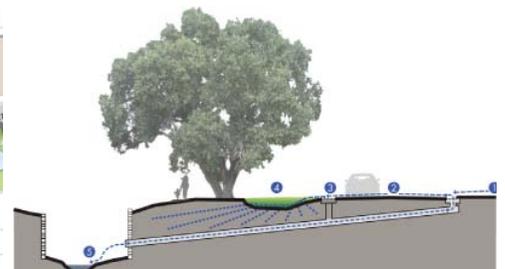
Concept Photomontage



Partial Schematic Vision Plan (St. Francis to Paseo)



Enlargement Plan at Don Gaspar



Stormwater Concept Section Diagram



Stormwater Acequia Photomontage



Depressed landscaping and water harvesting



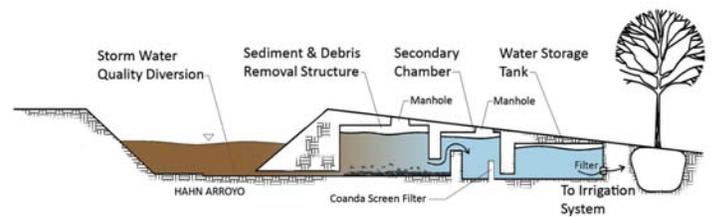
Permeable Pavement

At this site several low impact features have been installed. Note the permeable pavement. On the south side there is a regional retention pond. Depressed landscape areas collect stormwater and provide an initial filtration of the water. The site is located at 5401 Watson Dr. SE, Albuquerque, NM 87106. Take I-24 to Rio Bravo Exit East. Take University Blvd south to Crick Ave. Make a left on Crick Ave, then a right on Watson Dr. This site is accessible to the public at all hours.

Hahn Arroyo Desert Parkway Landscaping Solutions



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



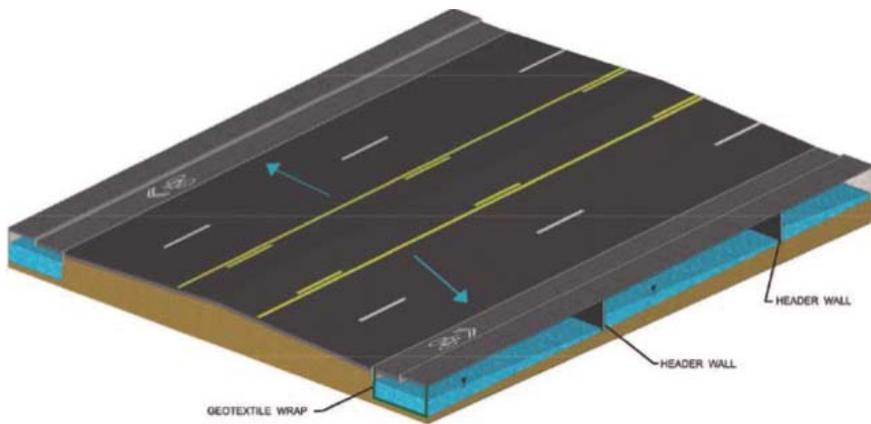
Setting Boulders And Native Plants

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.

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..

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.



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.

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.

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.



Cistern/Garden



Master Plan



Mound and Wall



Woven Brick Terrace



Stormwater Acequia

Sponsors



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