




# Green Infrastructure and Climate Change: An Arid Land Perspective

**George Radnovich, ASLA**  
**Sites Southwest**



In the West, the clear and present danger of climate change means Drought, Large Intermittent Rain Events, and Temperature Extremes. It also means Opportunities!



A photograph of a park scene. In the foreground, a small stream flows through a rocky bed. The background is filled with lush green trees and a playground with a swing set and a bench. The text is overlaid on the image in a black, serif font.

Global Warming is increasing  
Energy Demands as well as  
Water Scarcity.

Our Infrastructure is Getting  
Overburdened from large storms.

This is all decreasing  
Human Comfort

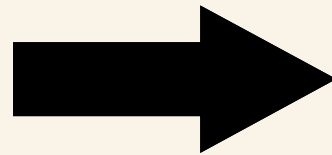




# Causes/Cures of Global Warming

**Burning  
Fossil Fuels**

**Deforestation**



**Use of Alternative Energy Sources**

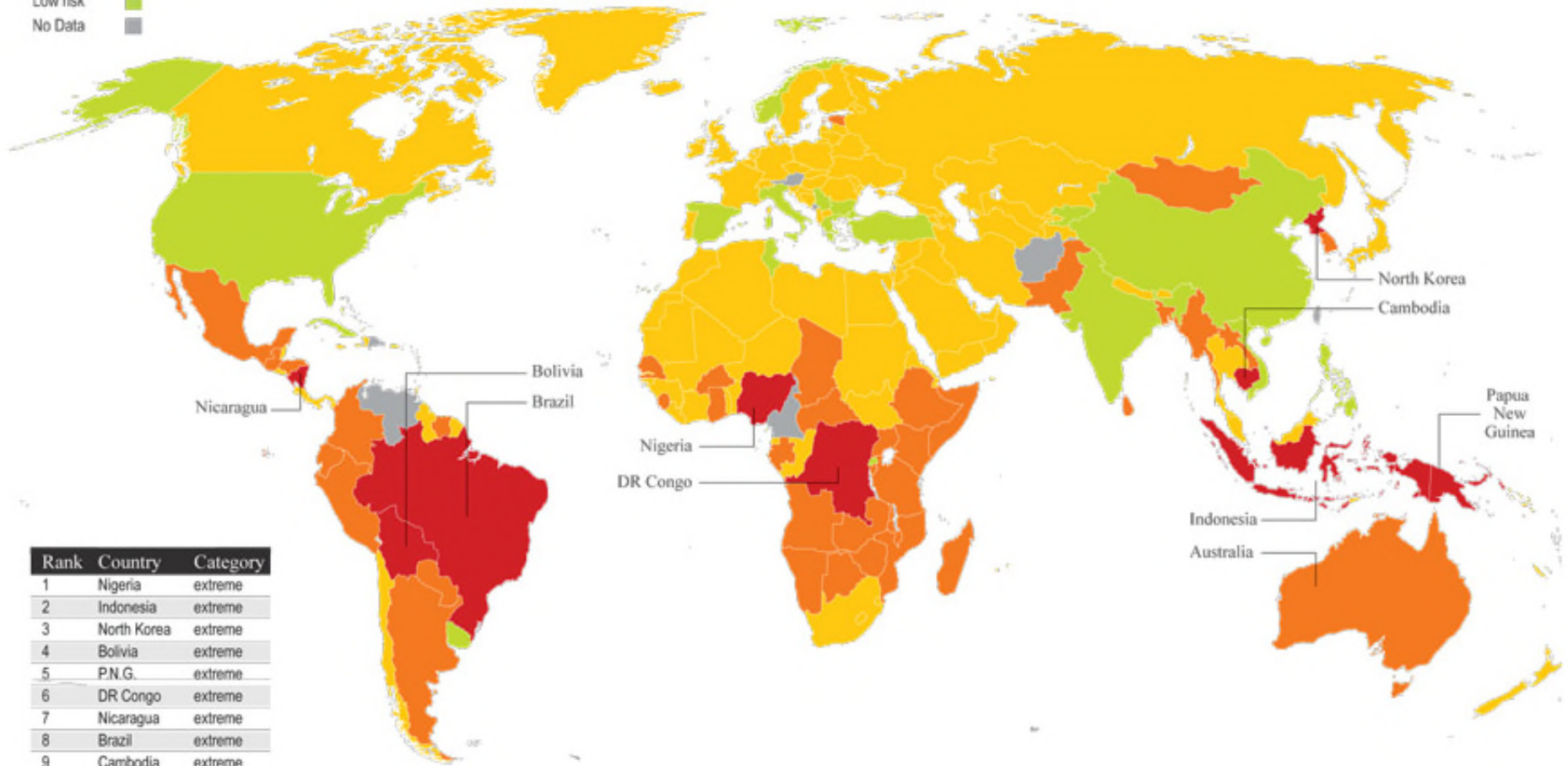
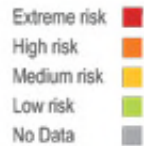
**Forestation / Landscaping**

There is substantial Carbon Storage in  
Urban Trees,  
700,000,000 Tons Total Nationwide

[http://www.fs.fed.us/psw/programs/uesd/uep/products/cufr\\_43.pdf](http://www.fs.fed.us/psw/programs/uesd/uep/products/cufr_43.pdf)



# Desertification and Deforestation



Rank	Country	Category
1	Nigeria	extreme
2	Indonesia	extreme
3	North Korea	extreme
4	Bolivia	extreme
5	P.N.G.	extreme
6	DR Congo	extreme
7	Nicaragua	extreme
8	Brazil	extreme
9	Cambodia	extreme
10	Australia	high



# Why Use Green Infrastructure

- **Money Savings: Integration of Stormwater, Infrastructure and Park/Open Space Projects**
- **Energy Savings: Trees Decrease Energy Demand and Reduce the Heat Island Effect**
- **Pollutant and Sediment Control**





# Why Use Green Infrastructure

- **Health Benefits (reduced UV, pollution, etc...)**
- **More Positive for Community Outreach**
- **Better Aesthetics in Infrastructure Projects**







# Urban Tree Cover



- **Losses of Urban Tree Canopy in the West**
- **Trees and vegetation remove and store carbon**
- **Trees slow stormwater runoff, decreasing the necessary amount of constructed stormwater storage.**
- **In 2007 Albuquerque's tree canopy provided 20 million cubic feet in stormwater detention services, valued at \$123 million (using a local \$6/cubic foot local cost (CABQ)).**



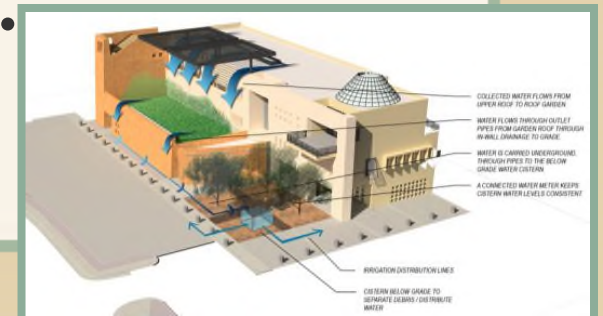


Reducing Global Warming through Green Infrastructure



# Arid Lands Approach

- Whole Systems Thinking
- Protect Land / Landscape
- Mimic Nature
- Harvest Water
- Technology: Cisterns, Hydrophilic Materials, Permeable Pavements, Etc...
- Increased Infiltration

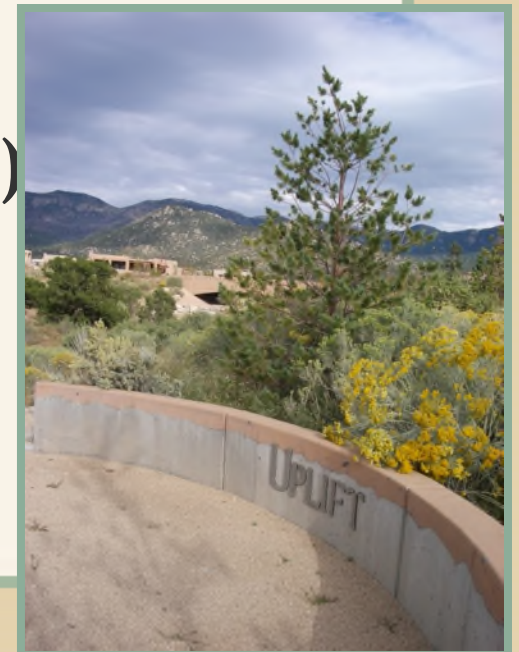






# Whole Systems Approach, Beyond LID

- Integration of Site with Culture / Economy
- Increased Safety
- Create more Multi-Modal Transportation Connections
- Dual Use facilities (reduce costs)
- Education / Interpretation/Art
- Wildlife Linkages
- Conserving water is important!





# **CASE STUDIES:**

**HIGH DESERT**

**HAHN ARROYO**

**BACHECHI OPEN SPACE**

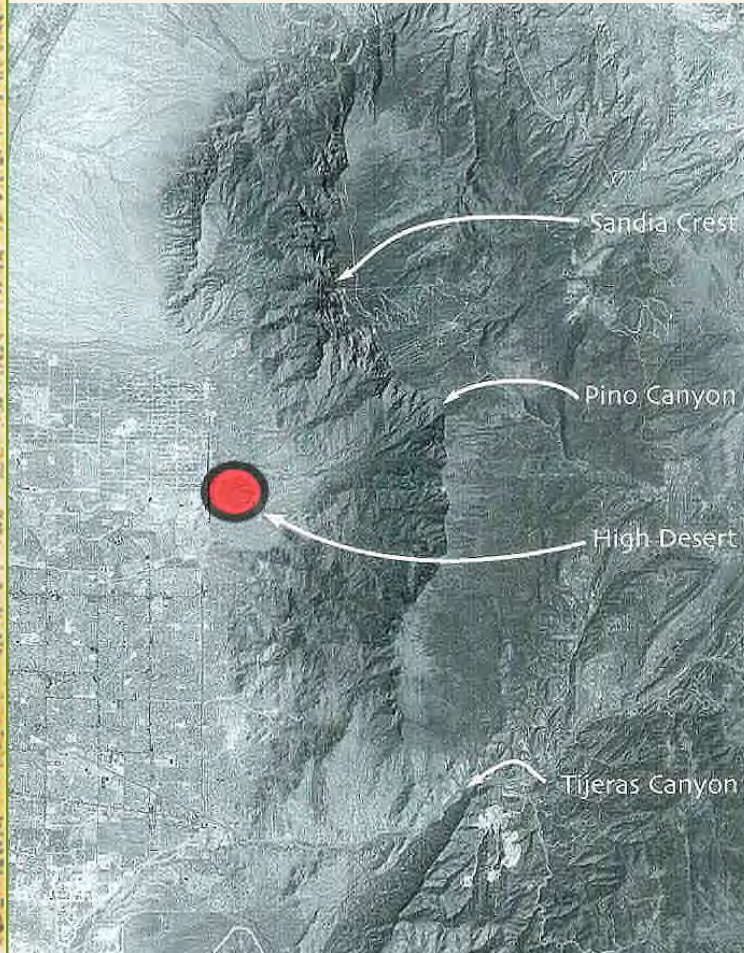
**BLACK ARROYO MASTER PLAN**

**NM COURT OF APPEALS**





# High Desert



Reducing Global Warming through Green Infrastructure





# Land Protection / Reuse of Materials



Reducing Global Warming through Green Infrastructure





# Mimic Natural Stormwater Systems



Reducing Global Warming through Green Infrastructure





# Water Harvesting

- **Collection Ponds**







# Water Harvesting

- **Conveyances**



Reducing Global Warming through Green Infrastructure





# Hahn Arroyo



Reducing Global Warming through Green Infrastructure





# Natural Stormwater Systems as the “Model”

























# Hahn Arroyo

## LEGEND

-  PLAZA (RECYCLED CONCRETE, GRAVEL, PAVERS, OR COLORED CONCRETE)
-  RECYCLED CONCRETE AND/OR BOULDER RETAINING WALL
-  BOULDER AND COBBLE CHECK DAM
-  WILDLIFE DRINKER
-  DOG BAG STATION
-  DOG DRINKER
-  SHADE STRUCTURE
  
- WATER HARVESTED AND IRRIGATED LANDSCAPE**
-  MEADOW DEPRESSIONS
-  NATIVE GRASS TURF
-  DECIDUOUS SHADE TREE
-  DECIDUOUS ACCENT TREE
-  EVERGREEN TREE
-  SHRUB BEDS
- RAINFALL ONLY**
-  EXISTING TREE
-  DECIDUOUS ACCENT TREE
-  EVERGREEN TREE
-  SHRUB BEDS
-  BERMS WITH NATIVE GRASS SEEDING AND XERIC TREES



CHANNEL



PATH



MEDIAN REFUGE



DOG BAG STATION



DOG DRINKER



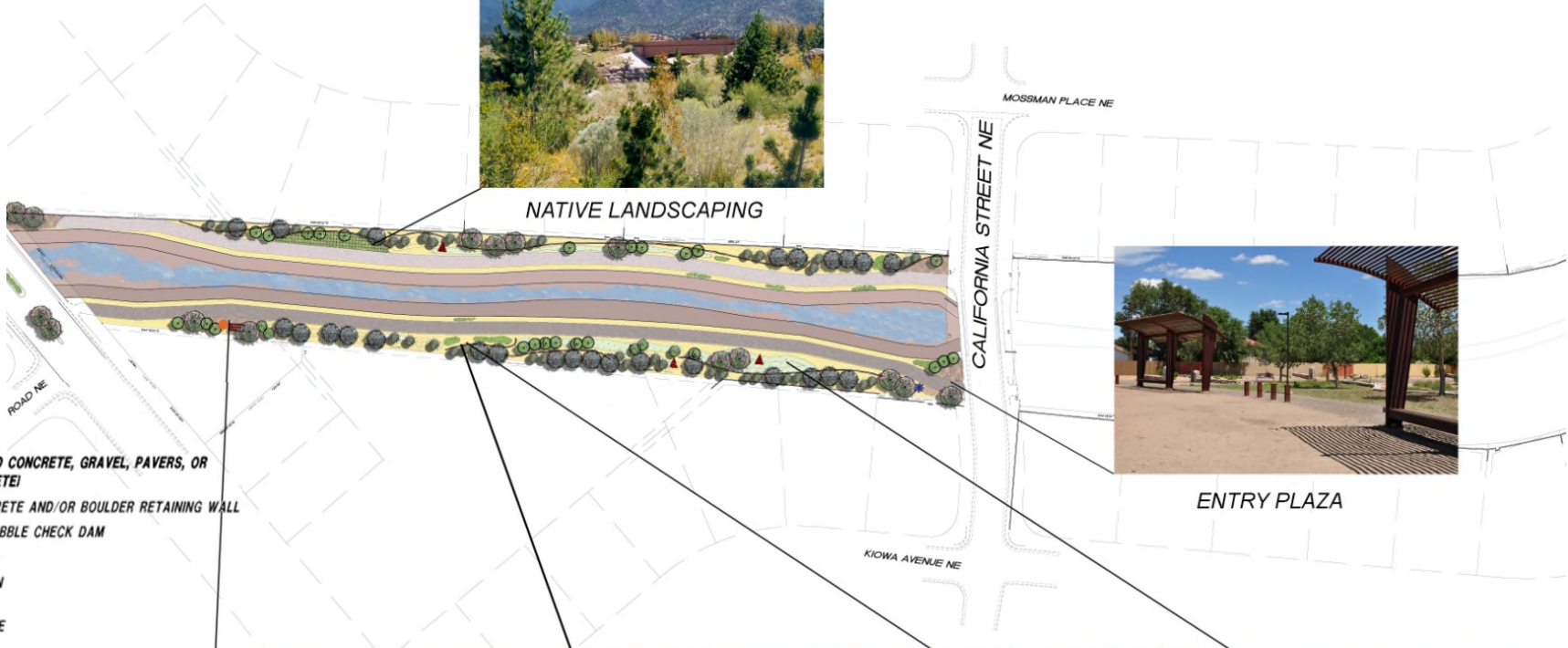
WAYFINDING SIGNAGE



NATIVE LANDSCAPING



ENTRY PLAZA



**LEGEND**

- PLAZA (RECYCLED CONCRETE, GRAVEL, PAVERS, OR COLORED CONCRETE)
- RECYCLED CONCRETE AND/OR BOULDER RETAINING WALL
- BOULDER AND COBBLE CHECK DAM
- WILDLIFE DRINKER
- DOG BAG STATION
- DOG DRINKER
- SHADE STRUCTURE

**WATER HARVESTED AND IRRIGATED LANDSCAPE**

- MEADOW DEPRESSIONS
- NATIVE GRASS TURF
- DECIDUOUS SHADE TREE
- DECIDUOUS ACCENT TREE
- EVERGREEN TREE
- SHRUB BEDS
- RAINFALL ONLY
- EXISTING TREE
- DECIDUOUS ACCENT TREE
- EVERGREEN TREE
- SHRUB BEDS
- BERMS WITH NATIVE GRASS SEEDING AND XERIC TREES



RECYCLED CONCRETE PAVERS



RECYCLED CONCRETE WALL



RECYCLED CONCRETE WALL



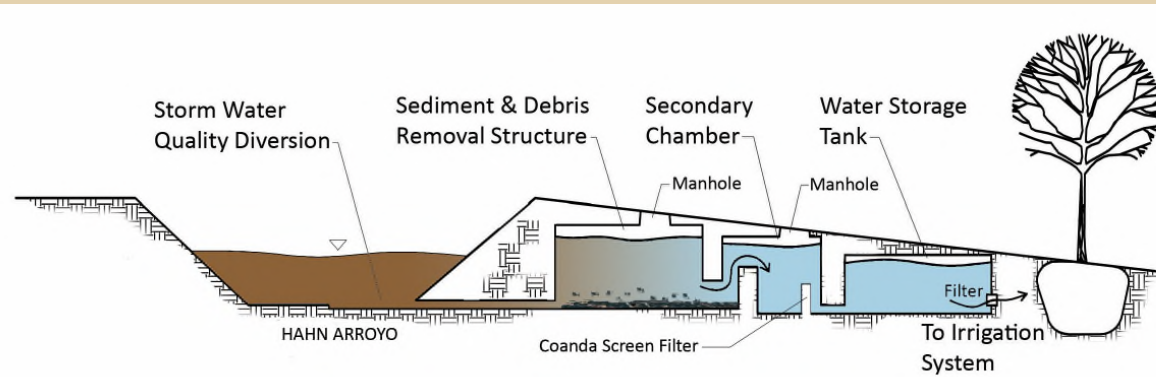
WILDFLOWER MEADOW





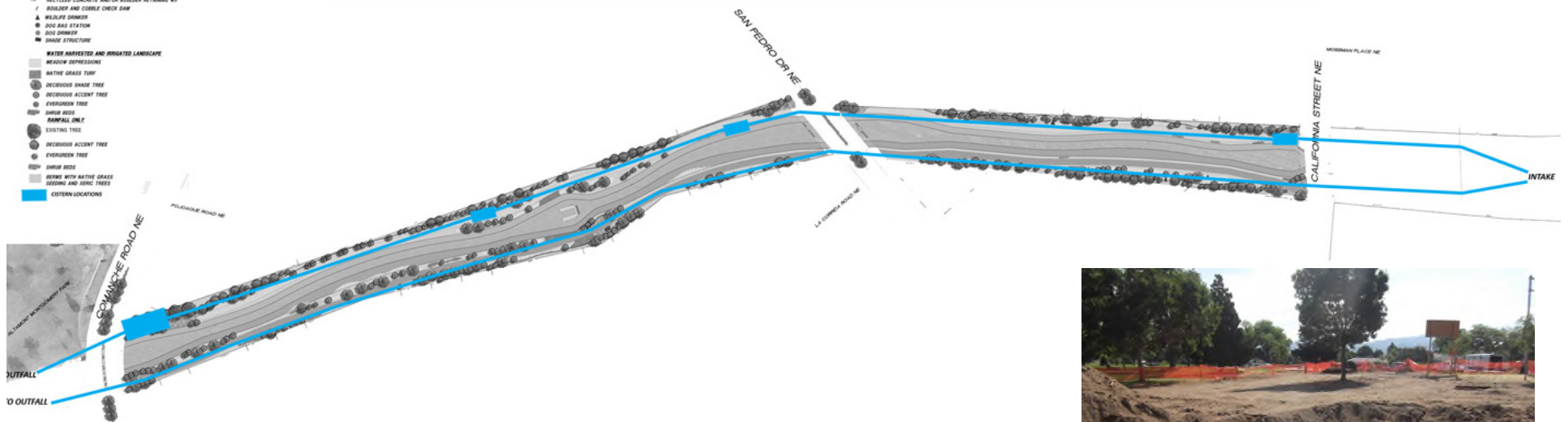


# Use of Cisterns

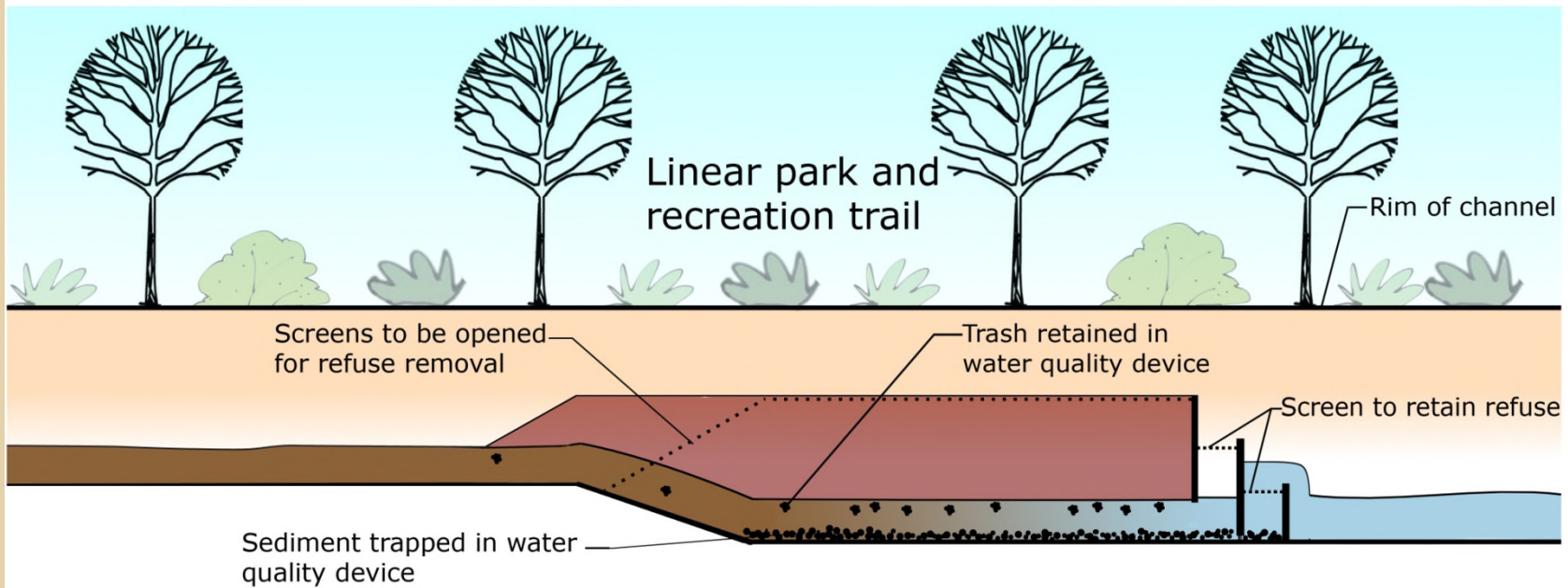
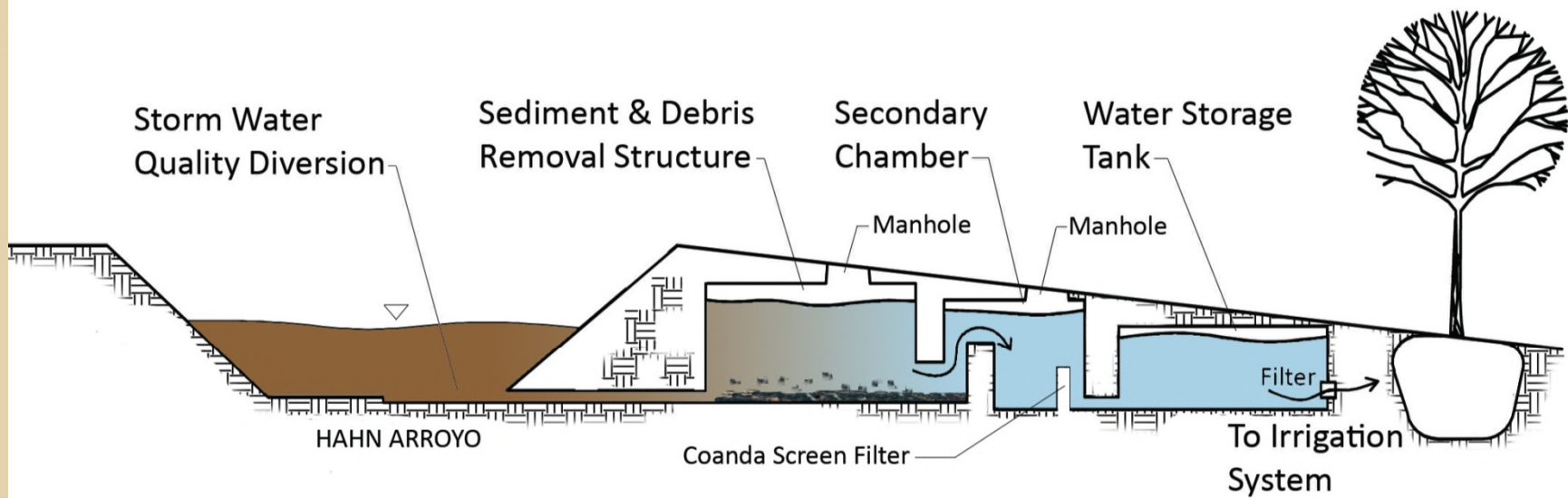


**LEGEND**

- PLAZA RECYCLED CONCRETE, GRAVEL PAVEMENT, OR COLORED CONCRETE
  - RECYCLED CONCRETE AND/OR BOLLER RETAINING WALL
  - BOLLER AND DOUBLE CHECK DAM
  - ▲ WILDLIFE DRINKER
  - DOG BAG STATION
  - DOG DRINKER
  - SHADE STRUCTURE
- WATER HARVESTED AND IRRIGATED LANDSCAPE**
- HEALTHY EXPRESSIONS
  - NATIVE GRASS TUMP
  - DECEADOUS SHADY TREE
  - DECEADOUS ACCENT TREE
  - EVERGREEN TREE
  - SHADY BEDS
  - RAINFALL ONLY
  - EXISTING TREE
  - DECEADOUS ACCENT TREE
  - EVERGREEN TREE
  - SHADY BEDS
  - BEDS WITH NATIVE GRASS SEEDING AND SHED TREES
  - CISTERN LOCATIONS



Reducing Global Warming through Green Infrastructure







Reducing Global Warming through Green Infrastructure





# Bachechi Open Space



Reducing Global Warming through Green Infrastructure



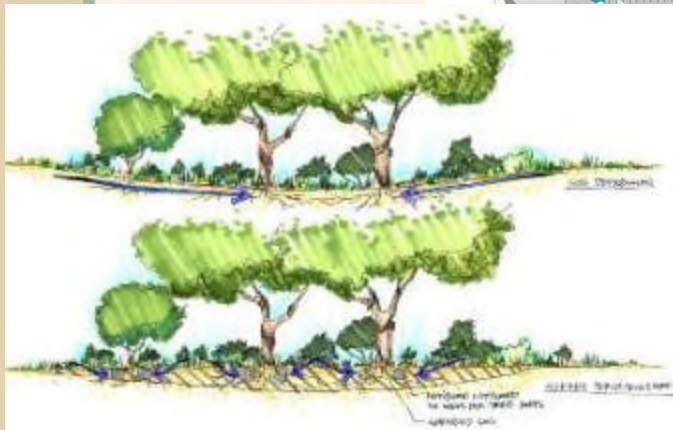


# Bachechi Open Space

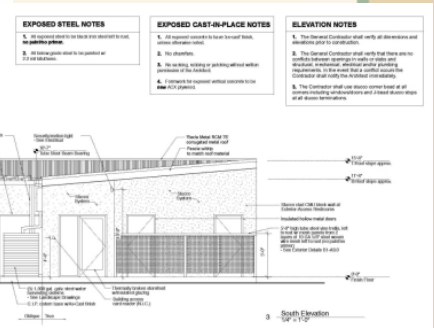
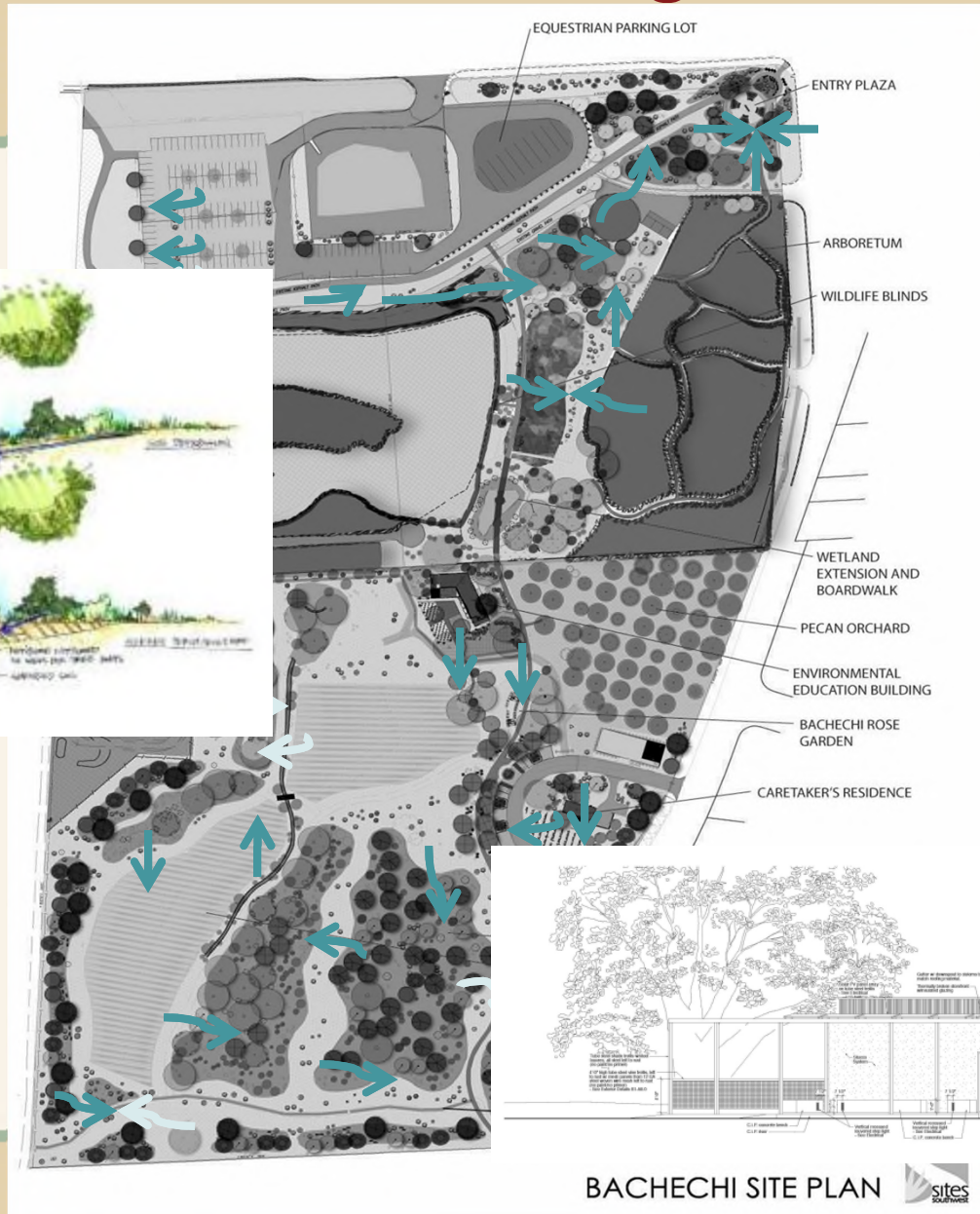




# Water Harvesting Concepts



SOIL DEPRESSION/WICKING SYSTEM



BACHECHI SITE PLAN 

Reducing Global Warming through Green Infrastructure



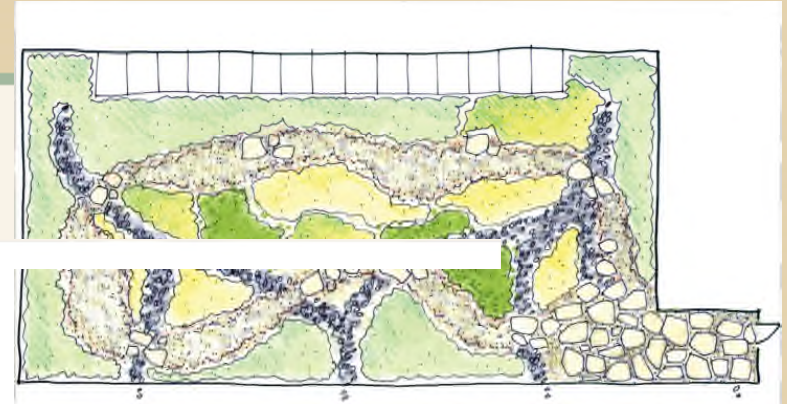


**Reducing Global Warming through Green Infrastructure**





# NM Court of Appeals, ca. 2008



COLLECTED WATER FLOWS FROM UPPER ROOF TO ROOF GARDEN.

WATER FLOWS THROUGH OUTLET PIPES FROM GARDEN ROOF THROUGH IN-WALL DRAINAGE TO GRADE.

WATER IS CARRIED UNDERGROUND, THROUGH PIPES TO THE BELOW GRADE WATER CISTERN.

A CONNECTED WATER METER KEEPS CISTERN WATER LEVELS CONSISTENT.

IRRIGATION DISTRIBUTION LINES

CISTERN BELOW GRADE TO SEPARATE DEBRIS / DISTRIBUTE WATER

Reducing Global Warming through Green Infrastructure



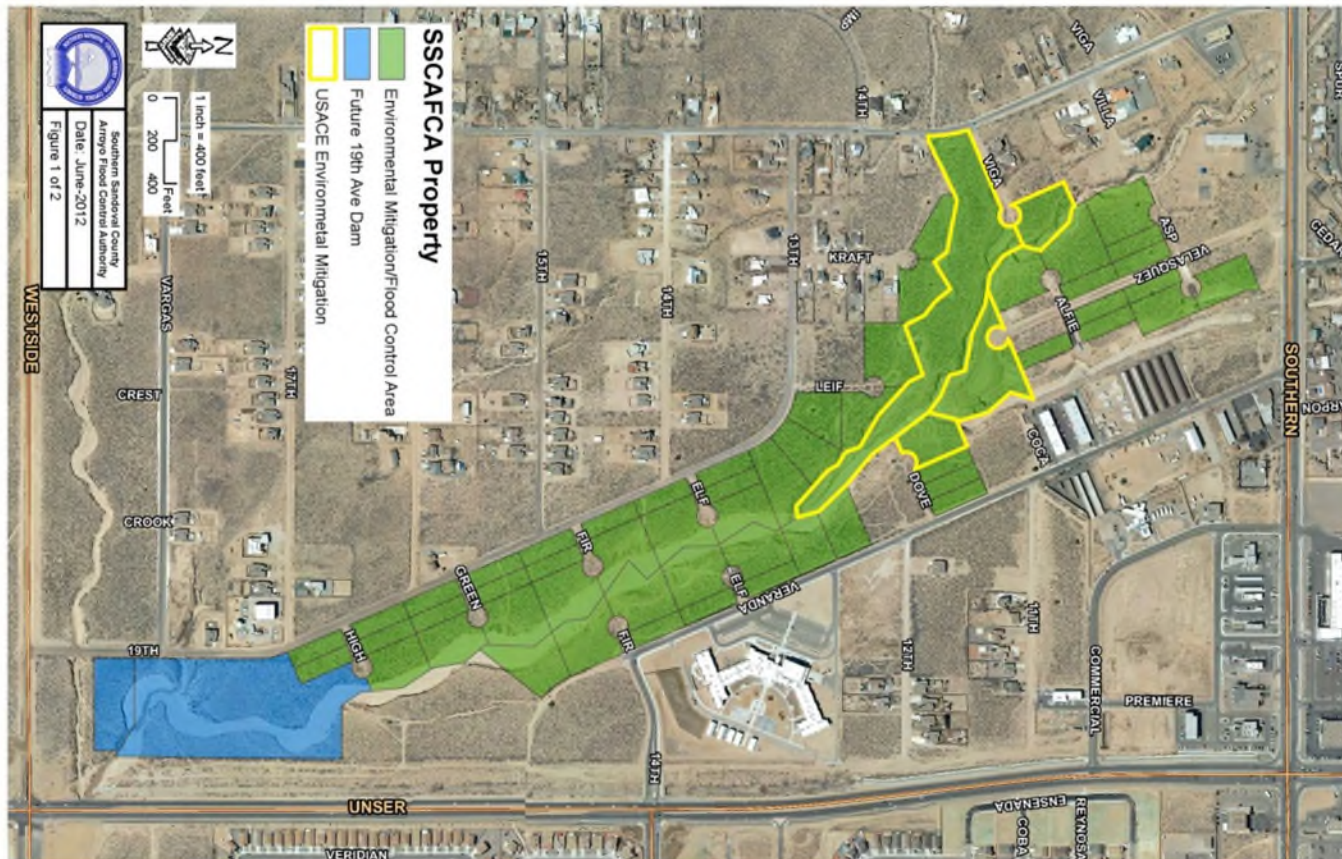


Reducing Global Warming through Green Infrastructure





# Black Arroyo Open Space

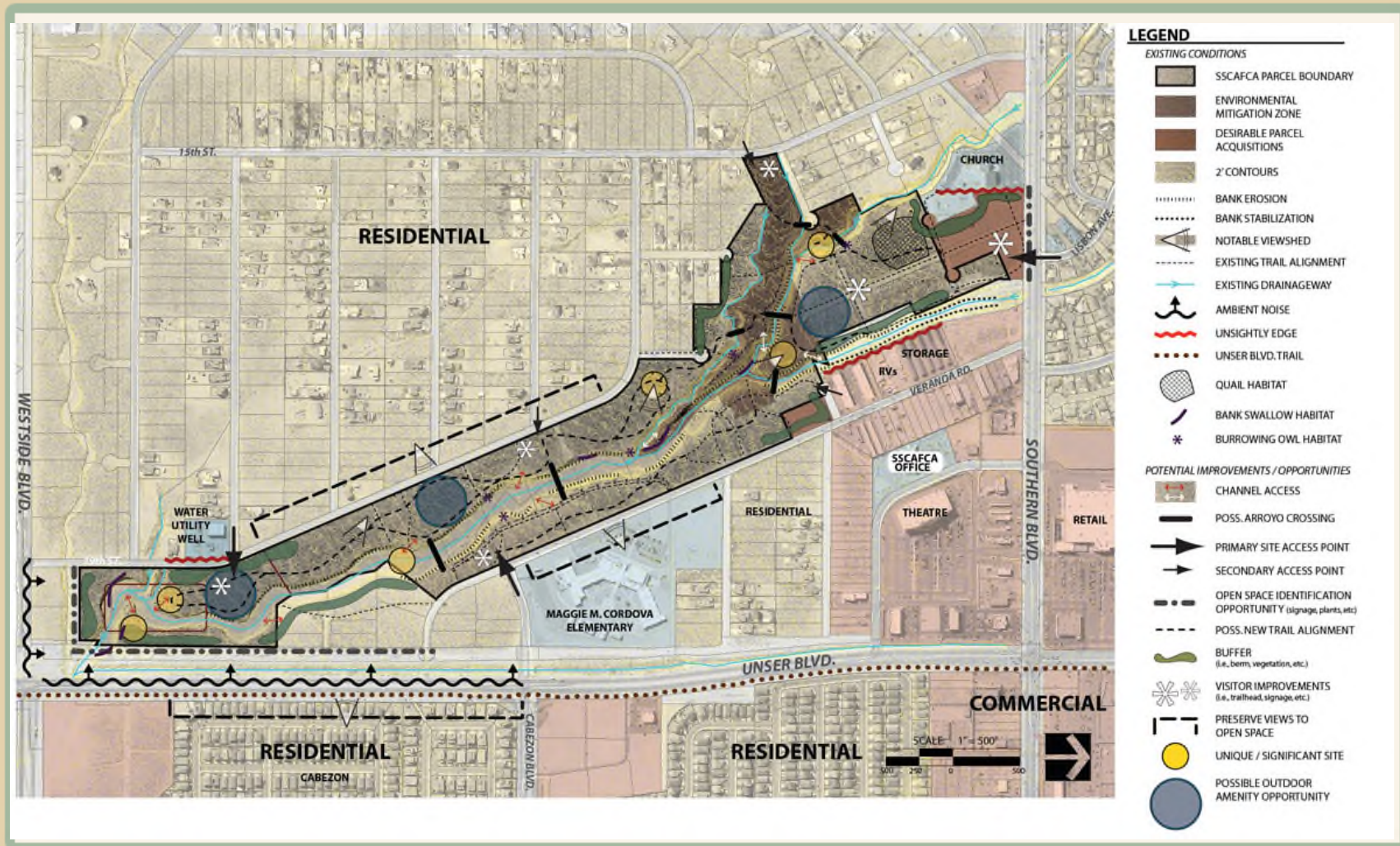


Reducing Global Warming through Green Infrastructure





# Opportunities & Constraints



Reducing Global Warming through Green Infrastructure





# The Master Plan



Reducing Global Warming through Green Infrastructure



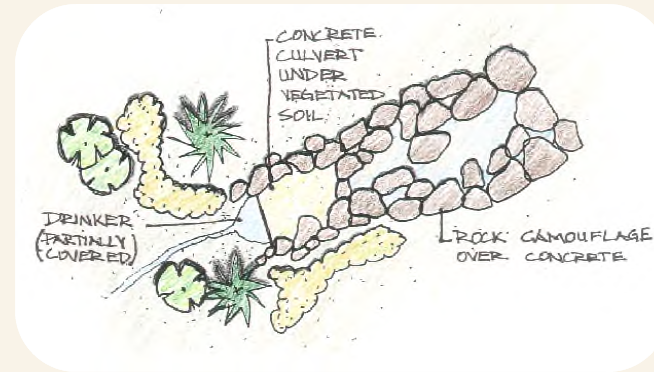


# Black Arroyo Open Space Draft Master Plan

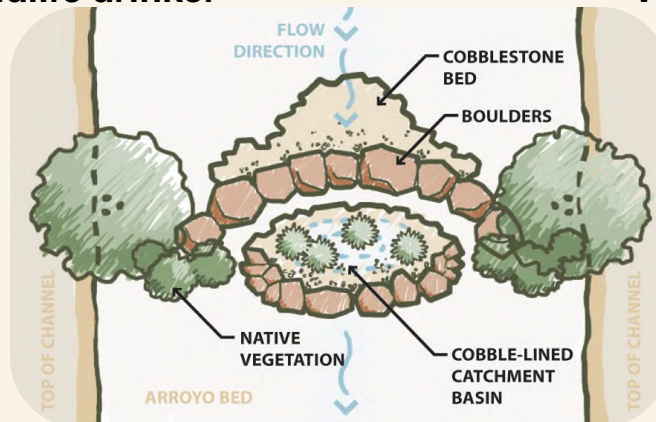
- Water harvesting and wildlife enhancement



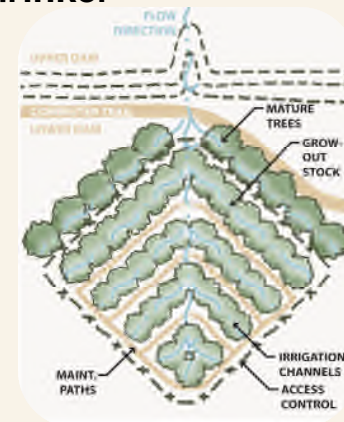
Wildlife drinker



Wildlife drinker



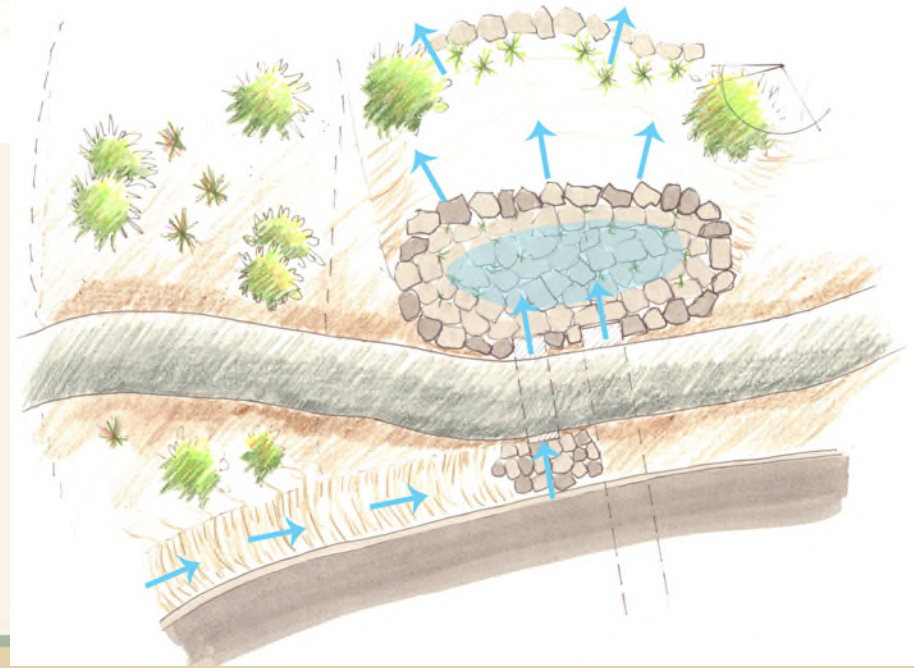
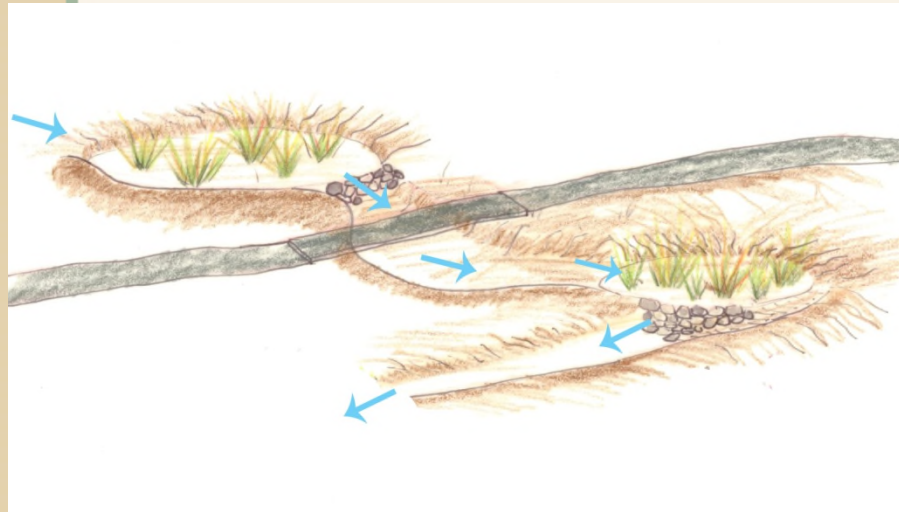
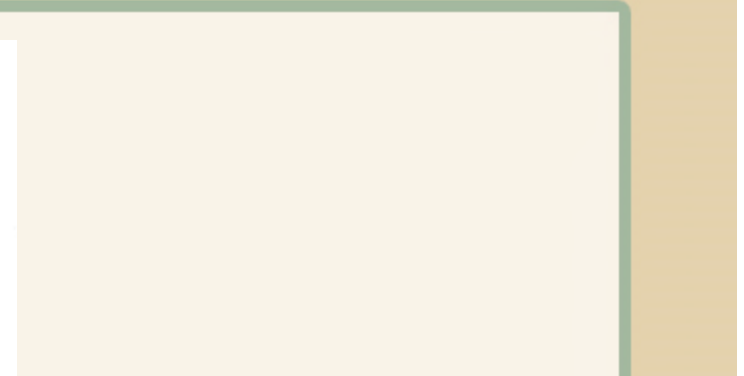
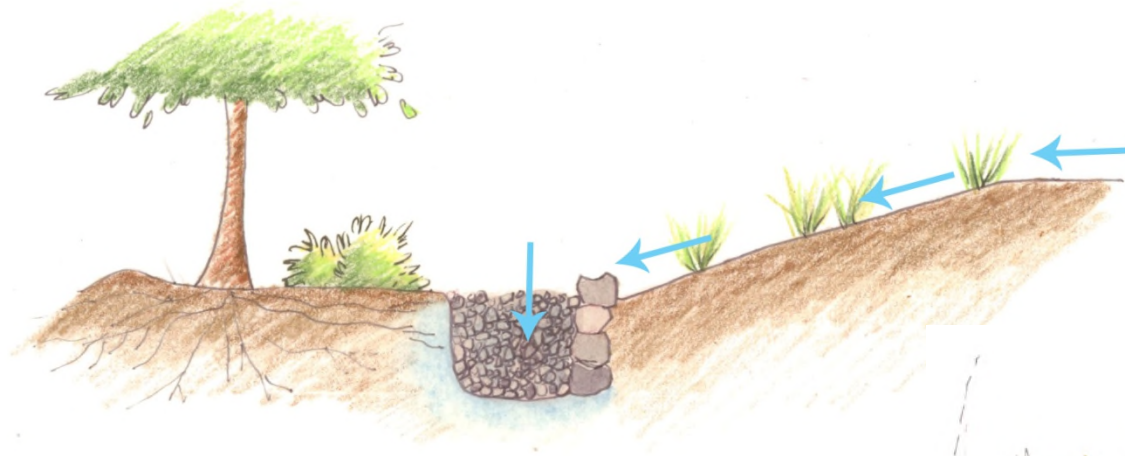
“Zuni bowl” water harvesting



Grow-out nursery



# Water Harvesting

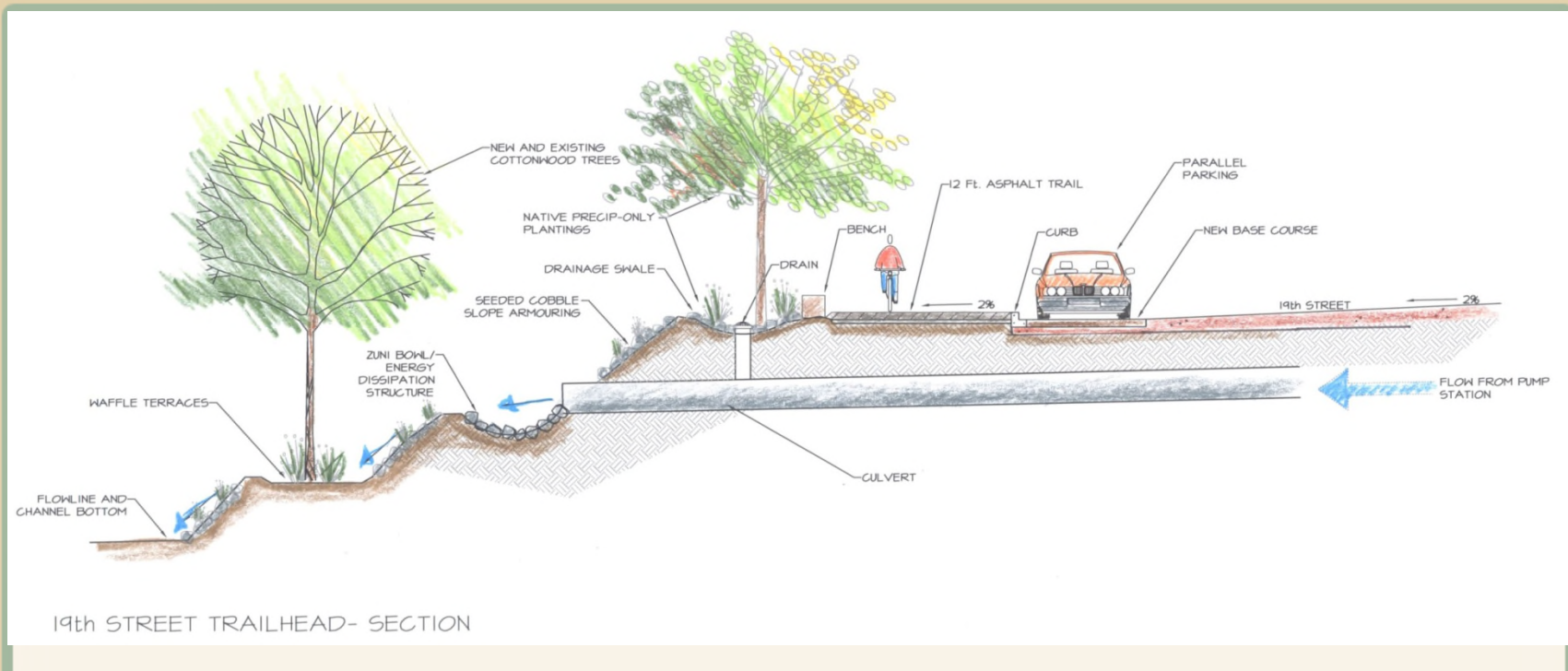


Reducing Global Warming through Green Infrastructure





# Trail Sections



Reducing Global Warming through Green Infrastructure



# Conclusions

- **Increased Infiltration**
  - Reduces construction and management costs
  - Reduces energy demand
- **Decentralizing Facilities**
- **Reduces Effects of Storms**
- **Naturalistic Treatment of Stormwater**
- **Increased Vegetative Cover**
  - Increased comfort
  - Increased carbon storage
  - Reduces erosion
- **Increases Aesthetics**
- **Economic Development Potential**





Thanks!



[grad@sites-sw.com](mailto:grad@sites-sw.com)

Reducing Global Warming through Green Infrastructure

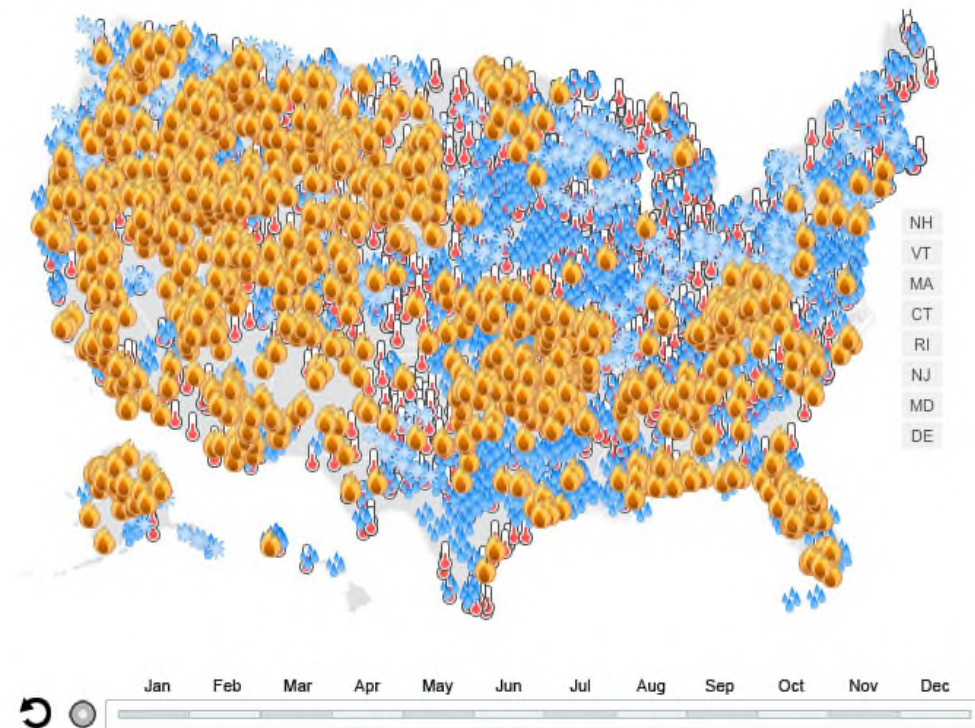


## Extreme Weather Map 2012

2012: Thousands More Weather Records Broken in the US, Costs Skyrocketing — Another "Year of What Climate Change Looks Like"

Climate change increases the risk of many types of record-breaking extreme weather events that threaten communities across the country. In 2012, there were 3,527 monthly weather records broken for heat, rain, and snow in the US, according to information from the National Climatic Data Center (NCDC).<sup>1</sup> That's even more than the 3,251 records smashed in 2011—and some of the newly-broken records had stood for 30 years or more.

Check out the interactive map below to find out what events hit your area.



### MAP LEGEND

- Record Temperature [i](#)
- Record Rainfall
- Record Snowfall
- Large Wildfires [i](#)
- FEMA-Declared Disaster or Emergency [i](#)
- Drought

» Download the map graphic:  
[JPG](#) | [PDF](#)

[Facebook](#) [Twitter](#)

[Email](#)

### 2012's Extreme Weather

Check out NRDC's new interactive map to watch 2012's extreme weather events across the country.

[Share on Facebook](#)





**Widespread use of LID practices would enable Southern California cities to import significantly less water, in turn reducing energy needs and associated CO2 emissions.**

**As one example, if all new residential and commercial development and redevelopment in urbanized Southern California started using LID practices, by 2030 CO2 emissions would be reduced by up to 292,000 metric tons per year.**