
# *Green Infrastructure for Arid Communities*

**Tuesday, March 24th, 2015**
**1:00 – 2:30pm EDT**

**Speakers:**

- **Neal Shapiro,** City of Santa Monica
- **Emily Brott**, Sonoran Institute

Sponsored by U.S. EPA Office of Wastewater Management

# Logistics

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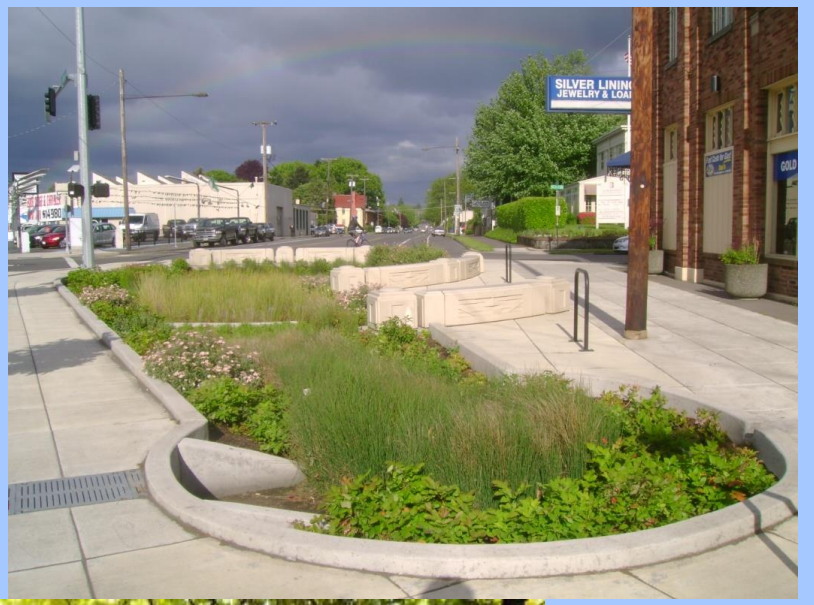
# Webcast Agenda

- **Speaker introduction**
- **Neal Shapiro,** City of Santa Monica
  - Rain Harvesting Green Infrastructure Strategies in Southern California
- **Emily Brott,** Sonoran Institute
  - Tucson's Conserve to Enhance and Living River Programs
- **Q&A session**



# Green Infrastructure for Arid Communities
# City of Santa Monica

Neal Shapiro
Office of Sustainability & the Environment

US EPA Webinar

March 24, 2015

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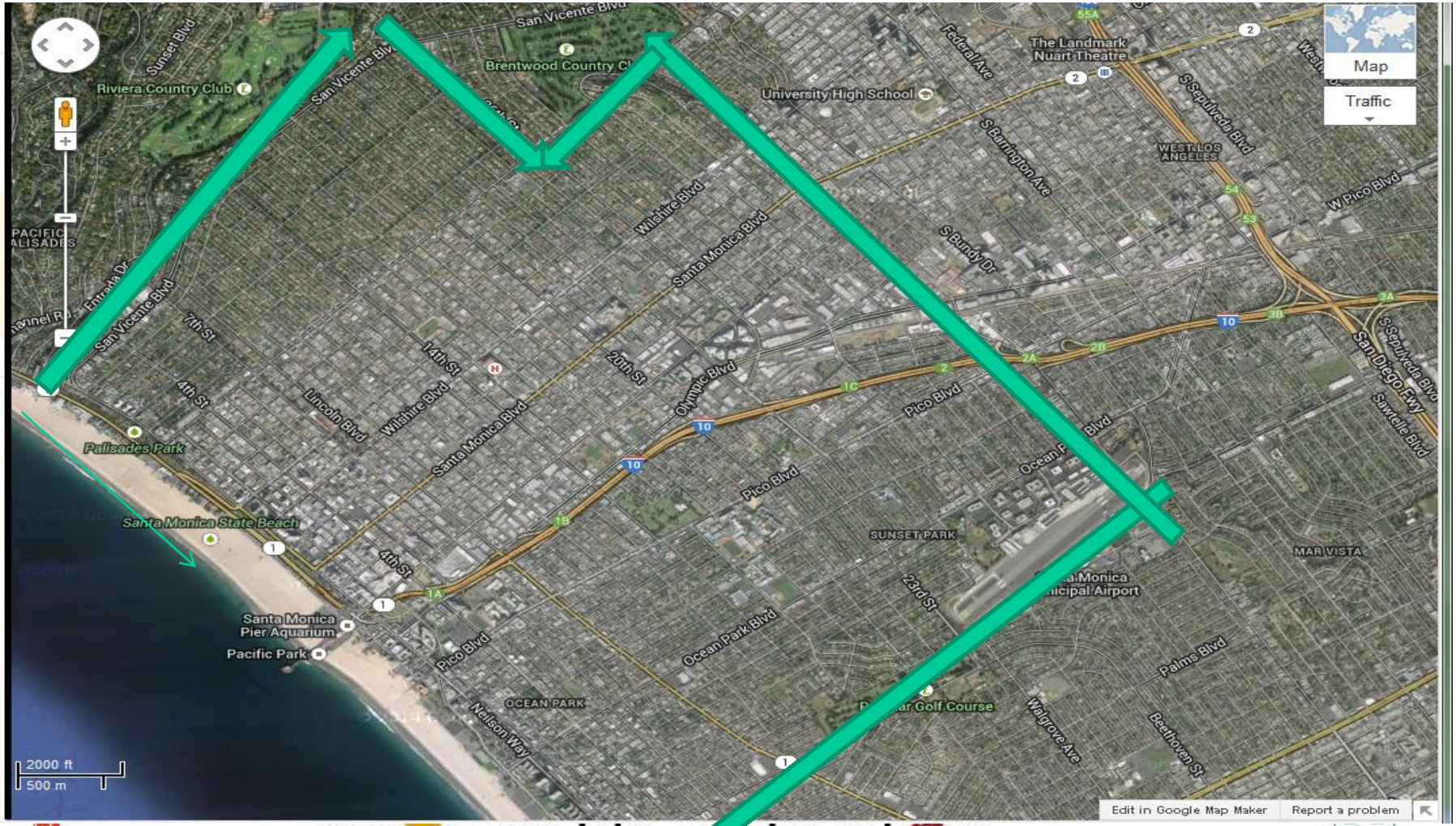
# Presentation Outline

- **Introduction to Problem**
- City's Sustainable Approach and Tools
- City Projects
- Private Projects
- City Green Streets
- City's SMURRF
- Conclusion

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## Water Resources Management

# Urban Runoff – What is it?

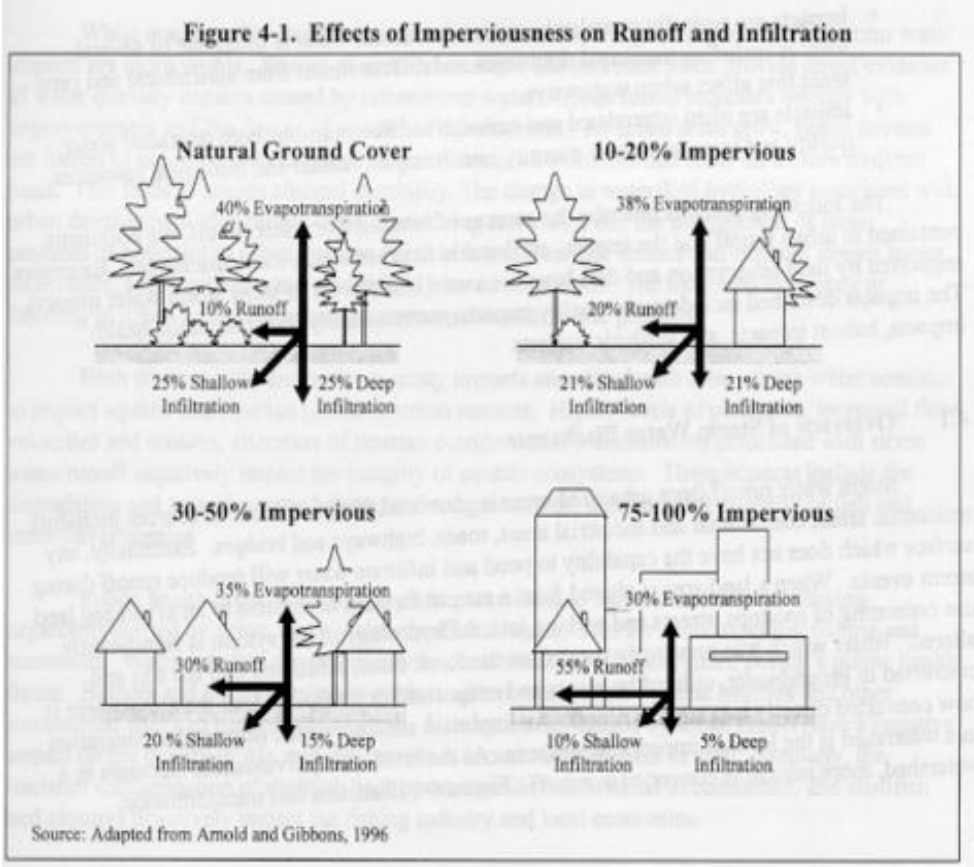
## The Problem – Water Quality v. Quantity

- The Southern California Coastal Water Research Project, a leading marine research group in Southern CA, reported that storm water and urban runoff are the leading source of water pollution in the Los Angeles area; storm water pollution has increased 200-700 percent during the last 20 years.

- Stormwater has become a lethal cocktail of pollutants that now constitutes the single greatest source of water pollutants, contributing 50-60 percent of the pollutant load.
- Types and Sources of Pollutants
- According to the US EPA, urban stormwater is the largest source of water quality damage in estuaries, the second largest for wetlands degradation, third largest impairment of lakes and fourth largest source of river damage.

# The Watershed Level –

## Disrupting the Water Cycle





- **How water flows through our environment**

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# Runoff Treatment Solutions Staircase

## A Paradigm Hierarchy Shift

High

BMP Preference

Reduction

Treat-Release

- Rainwater Harvesting 
- Subsurface Infiltration 
- Surface Infiltration 
- Biofiltration 
- Filtration 
- Hydrodynamic Separation 
- Detention 

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# OBJECTIVES

- ✓ Treat all dry weather and most wet weather urban runoff in the City
- ✓ Connect land use/design to the Hydrologic Cycle, reducing the disconnect and disruption of water flow
- ✓ Mimic nature; blend into the land
- ✓ Take proactive, watershed approach to reducing urban runoff problems
- ✓ Converting **IMPERMEABLE TO PERMEABLE**
- ✓ **Store** urban runoff (dry/wet weather) for **passive and direct uses** and **pollution treatment – Water Quality and Quantity Solutions**

# Tools of the Trade

- Education
- Prevention
- Ordinances
- Treatment
- Maintenance
- Enforcement
- Funding

# ORDINANCES

- Urban Runoff Pollution (LID) Mitigation Code. 7.10 SMMC –costs borne by property owner.
- Stormwater Utility Parcel Fee, 7.56 SMMC – fund generator, public projects.
- Clean Beaches & Ocean Special Tax. 7.64 SMMC - fund generator, public and private projects.
- 2020 Sustainable Water Master Plan.
- NPDES Permit, Enhanced Watershed Management Plans EWMPs – focus on GI

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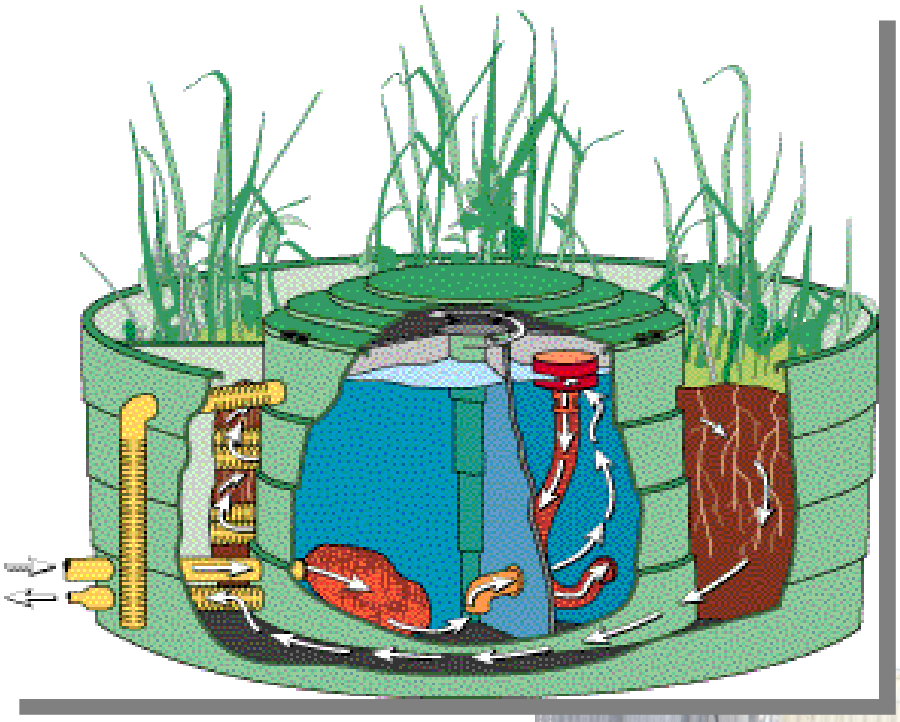
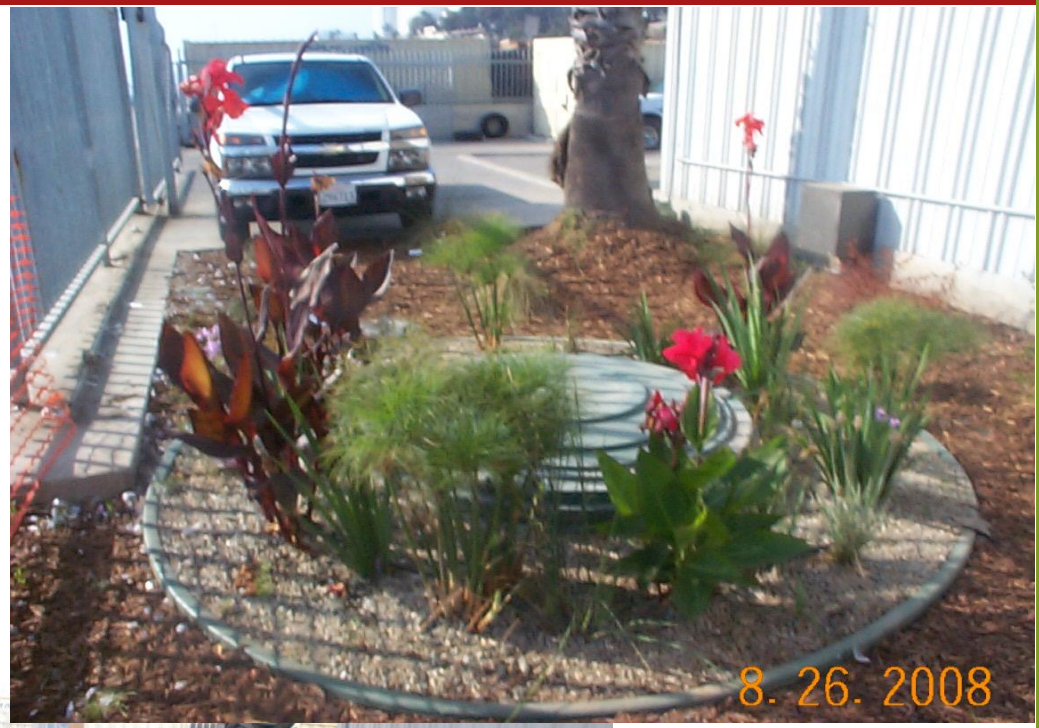
# TREATMENT – Public Projects

- Infiltration fields
- Porous surfaces
- Filtering
- Rainwater/Stormwater Harvesting & Use
- Federal, state, county grants – fund projects

# Onsite Natural Infiltration/Filtration



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# Onsite Retention – Drivable Surfaces



Permeable Alleys (pervious concrete, gravelpave)

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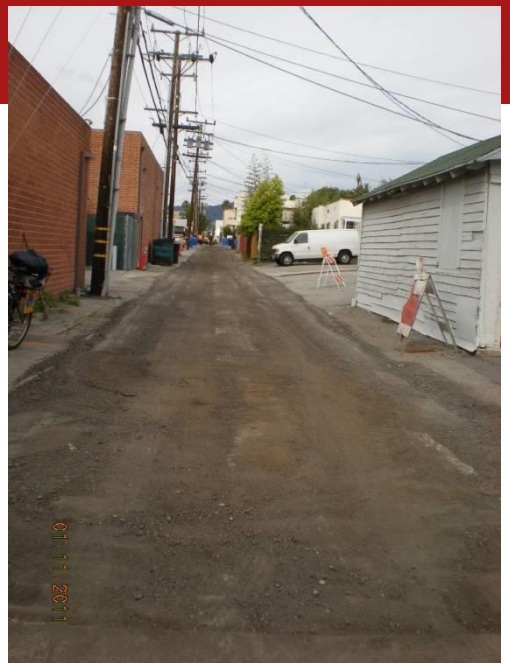
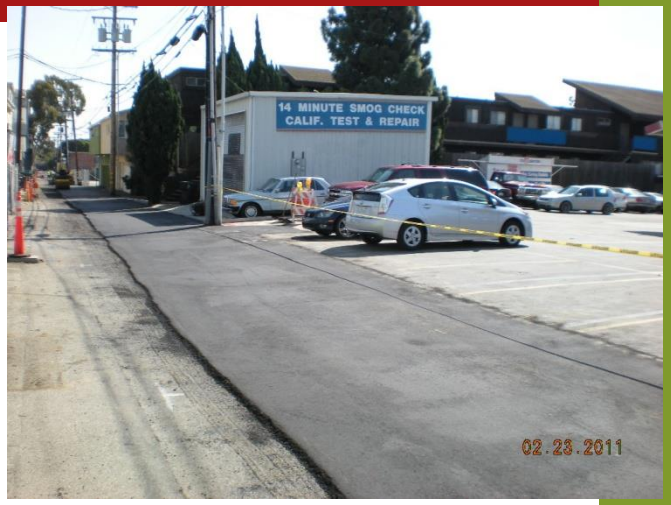
Green Alley Projects – 2011: Before (ongoing)











# Green Alley Projects – 2011: Construction

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# Green Alley Projects – 2011: After

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Permeable
Intersection Swales
(pervious concrete)

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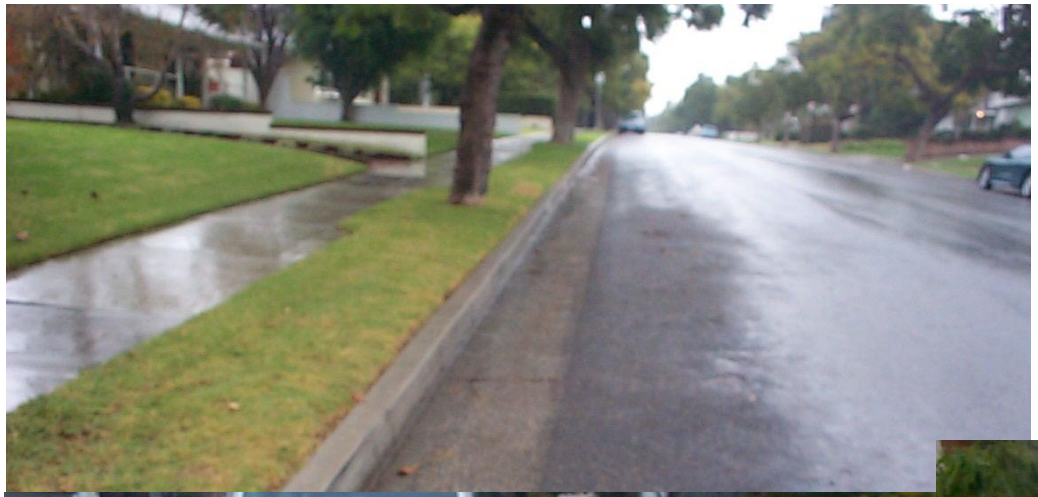
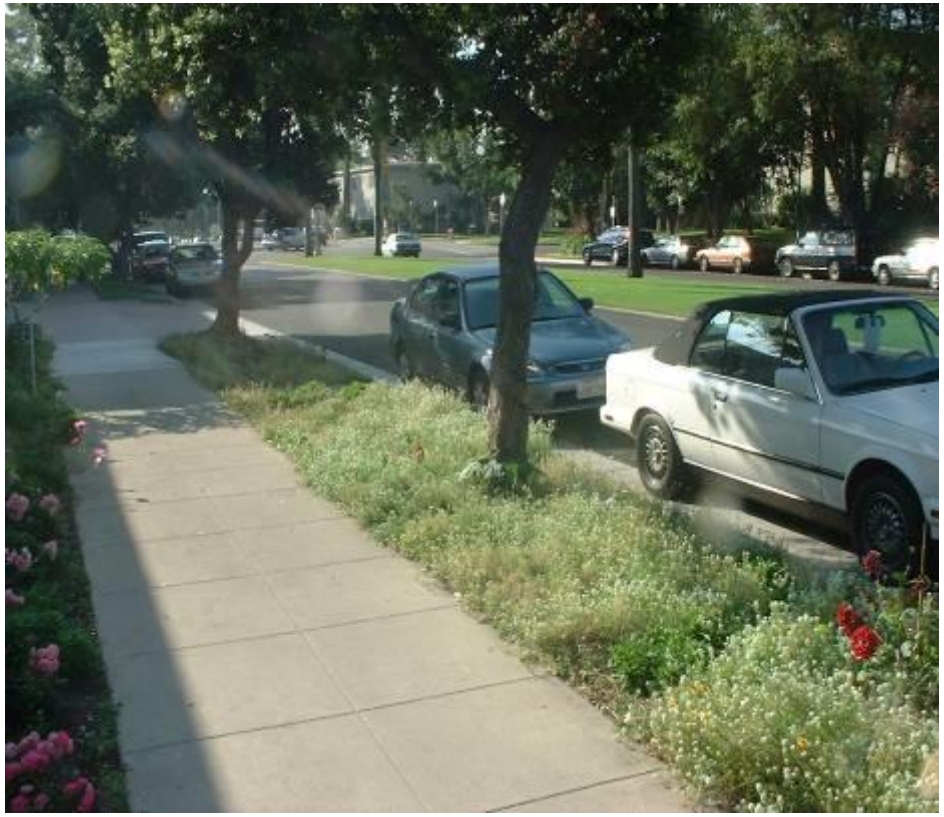
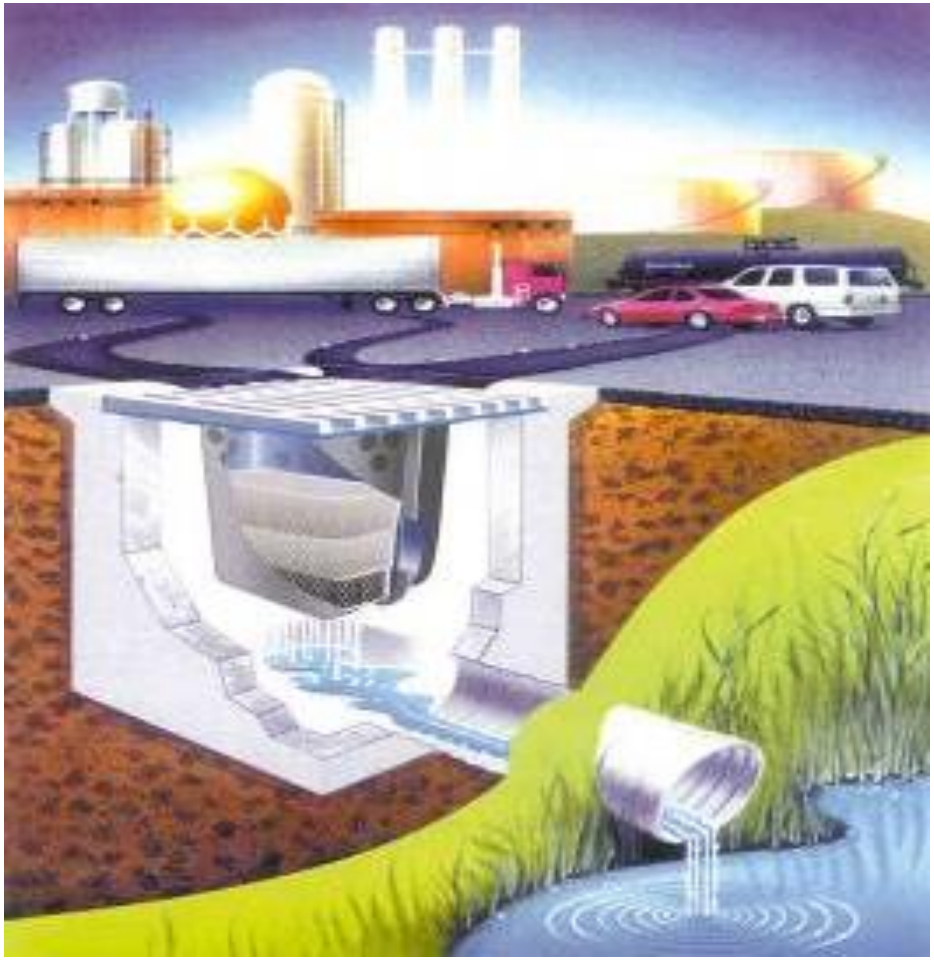
Permeable Gutters
(pervious concrete)

# Permeable Paving - Gutters




# Use of Parkways for Surface Runoff





# Parkway Infiltration



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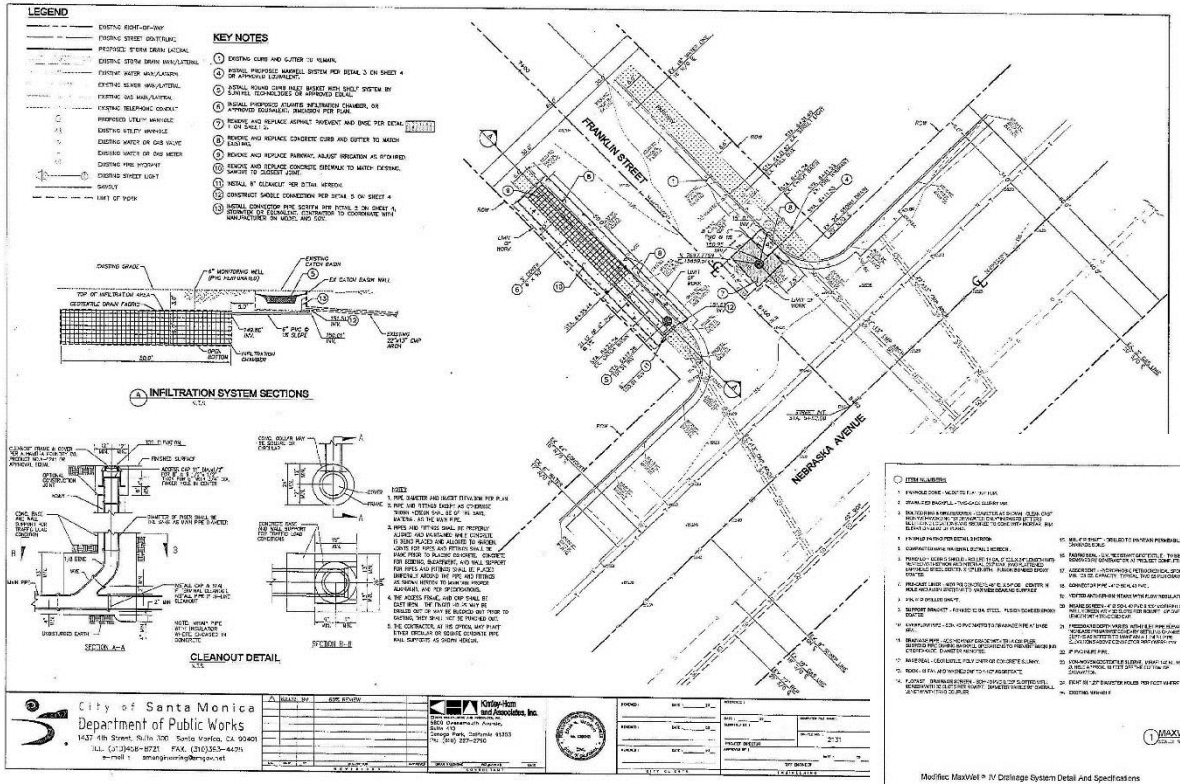
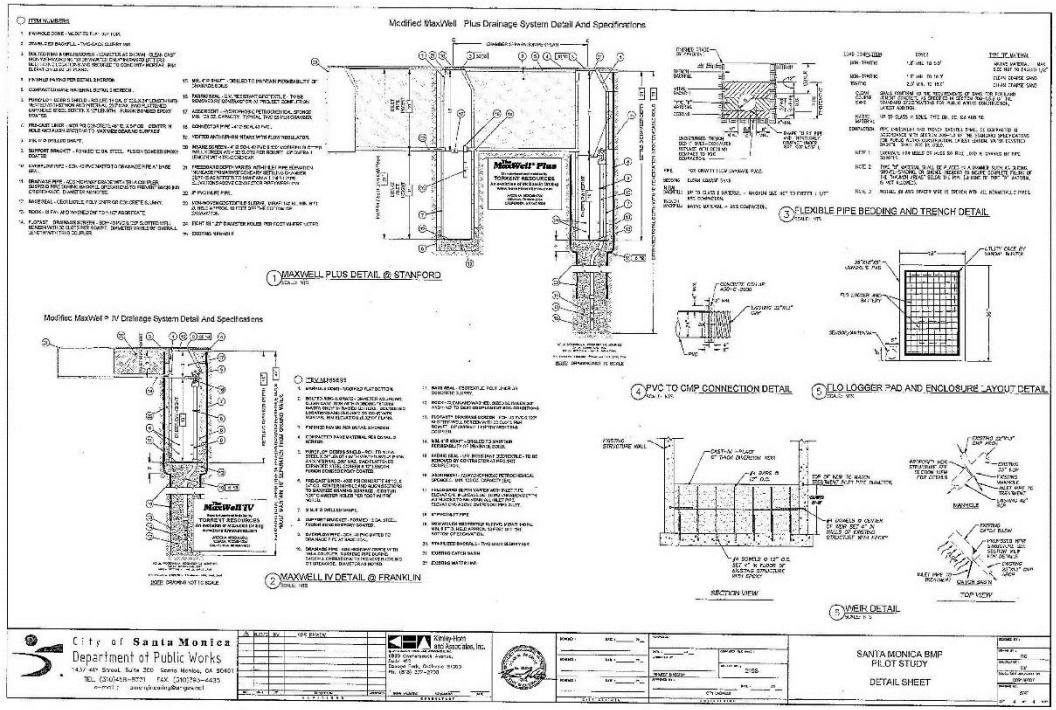
# In-Line Stormwater Harvesting

## Use of Parkways and Catch Basins for Sub-Surface Runoff

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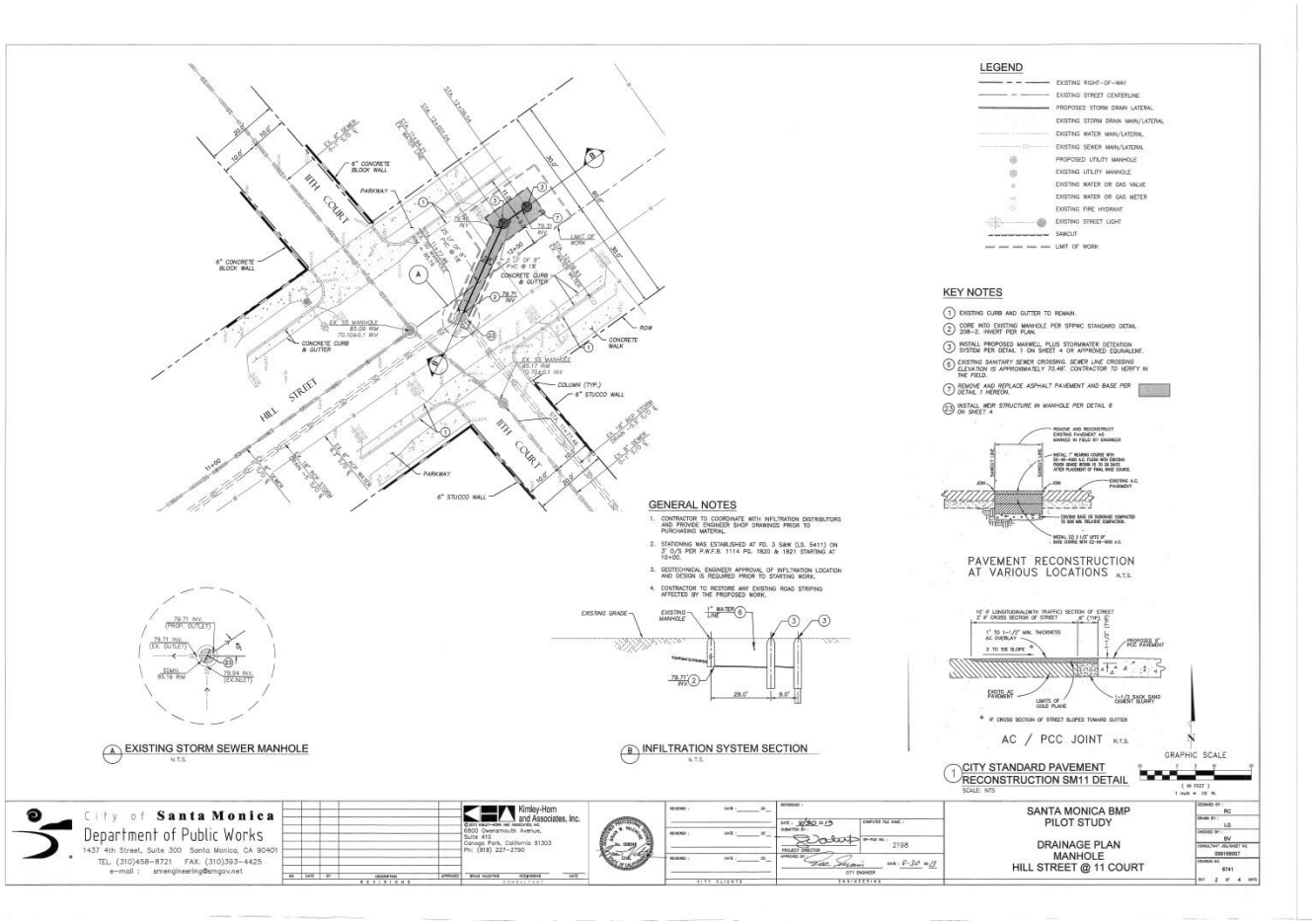
# In-Line Stormwater Harvesting


# In-Line Stormwater Harvesting

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# In-Line Stormwater Harvesting



# Virginia Avenue Park


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# Airport Park



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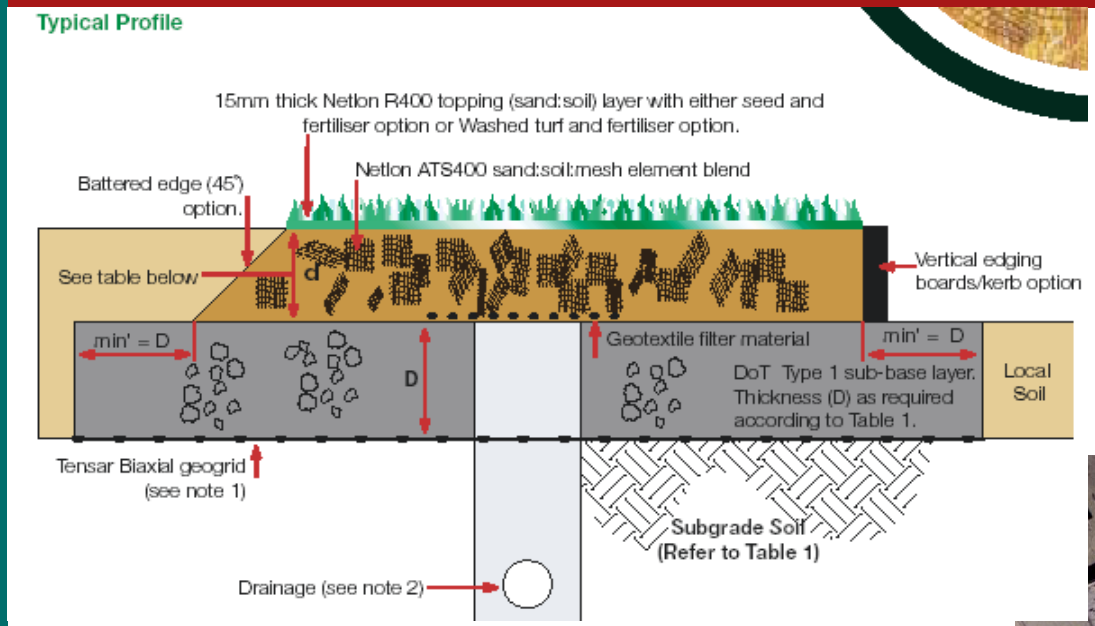
# Big Blue Bus Retention - PhI

# Big Blue Bus Retention: Phase II


# 415 Pacific Coast Highway - Retention

# Green Beach Parking Lot Project




Netlon Advanced Turf System



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# Green Beach Parking Lot Project



# Onsite Storage/Use - Main Library



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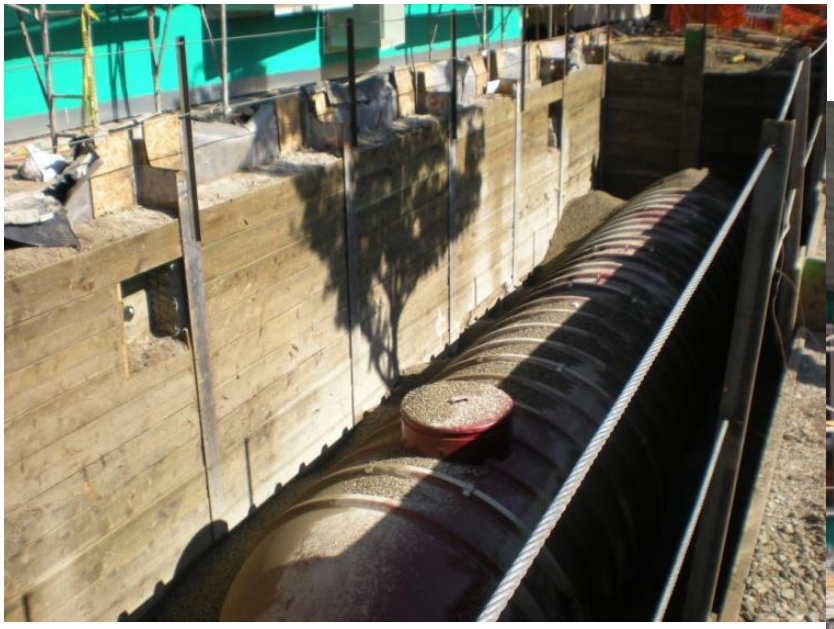
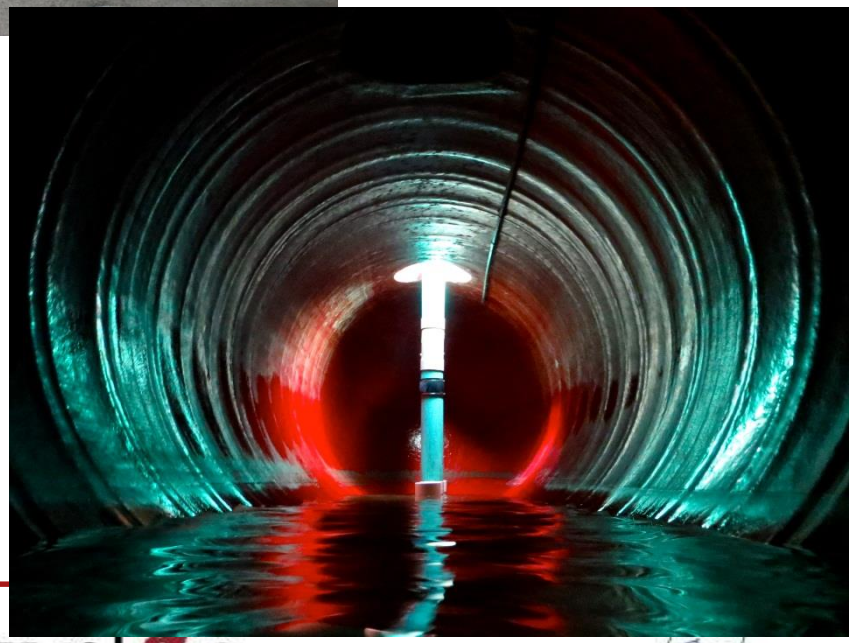
# Multi-Family Project



# Virginia Ave. Park Library



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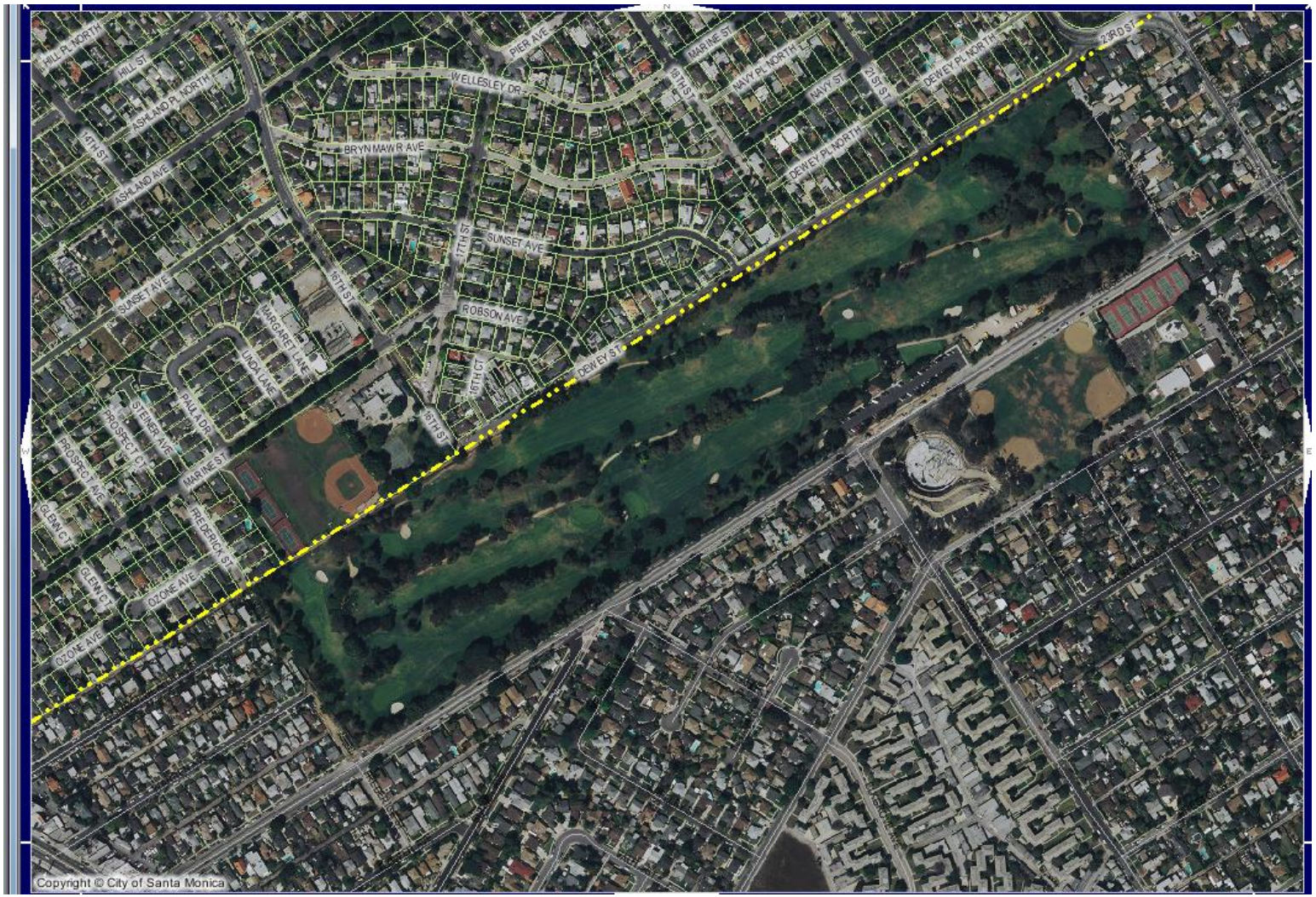
# Virginia Ave. Park Library

# Future Projects – Marine Park

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# Los Amigos Park Project



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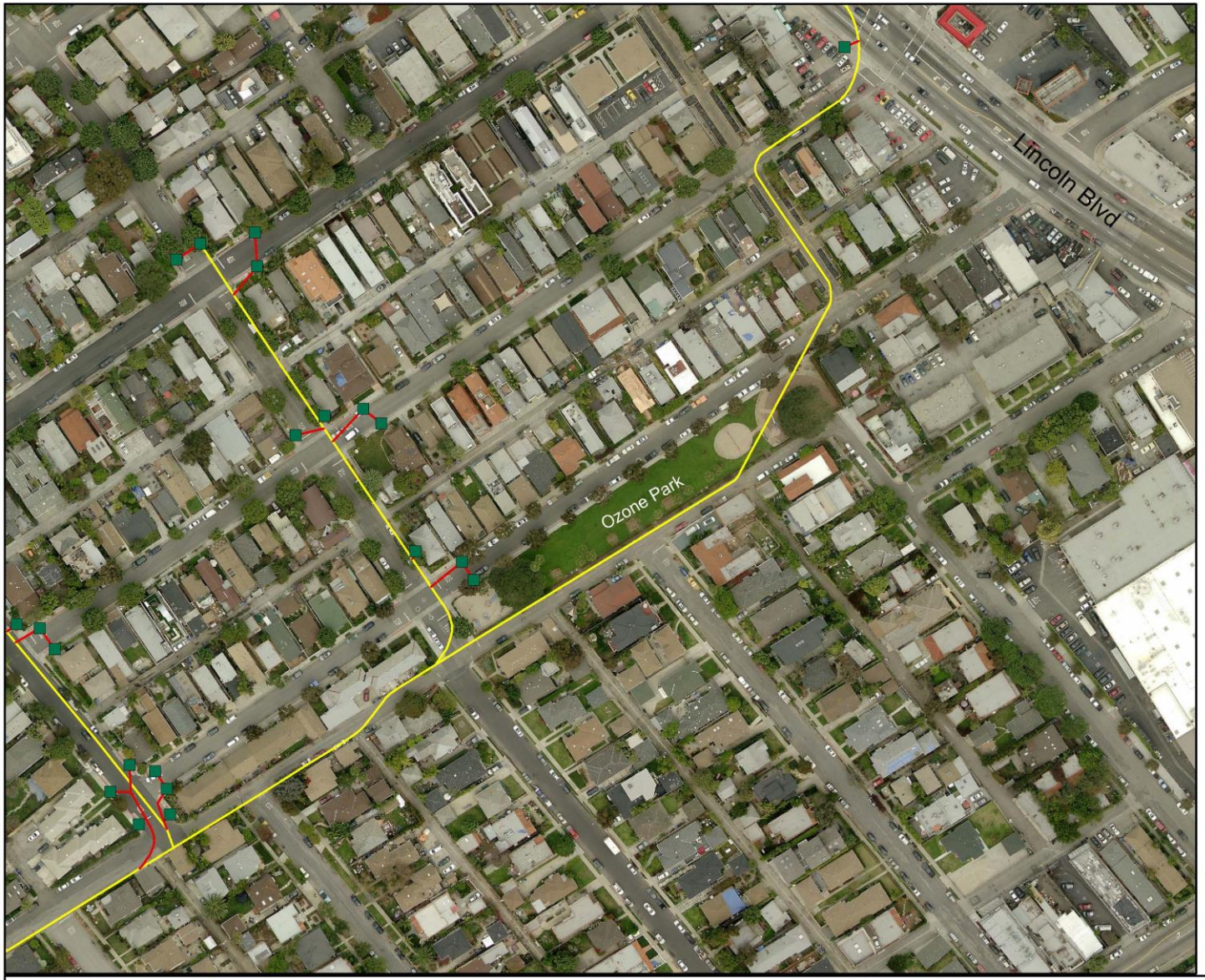
# Ozone Park Project



# Ozone Park Project

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# TREATMENT – Small Scale Privates

- Infiltration fields
- Porous surfaces
- Rain barrels and cisterns

# Onsite Retention-private businesses

# Drywell BMPs-single/multi- family


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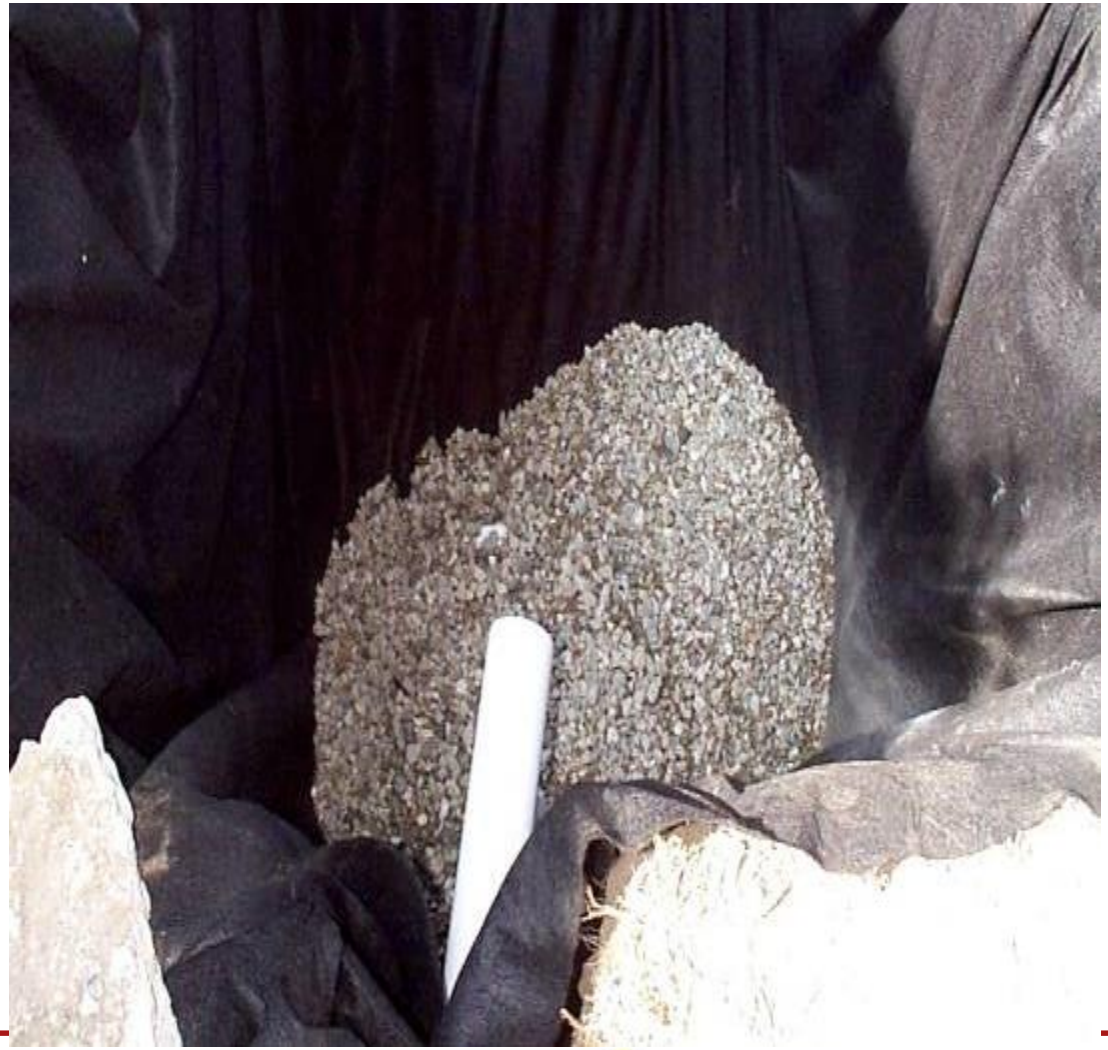
# Infiltration Pits BMPs



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# Onsite Retention

Invisible Structures

# Onsite Retention

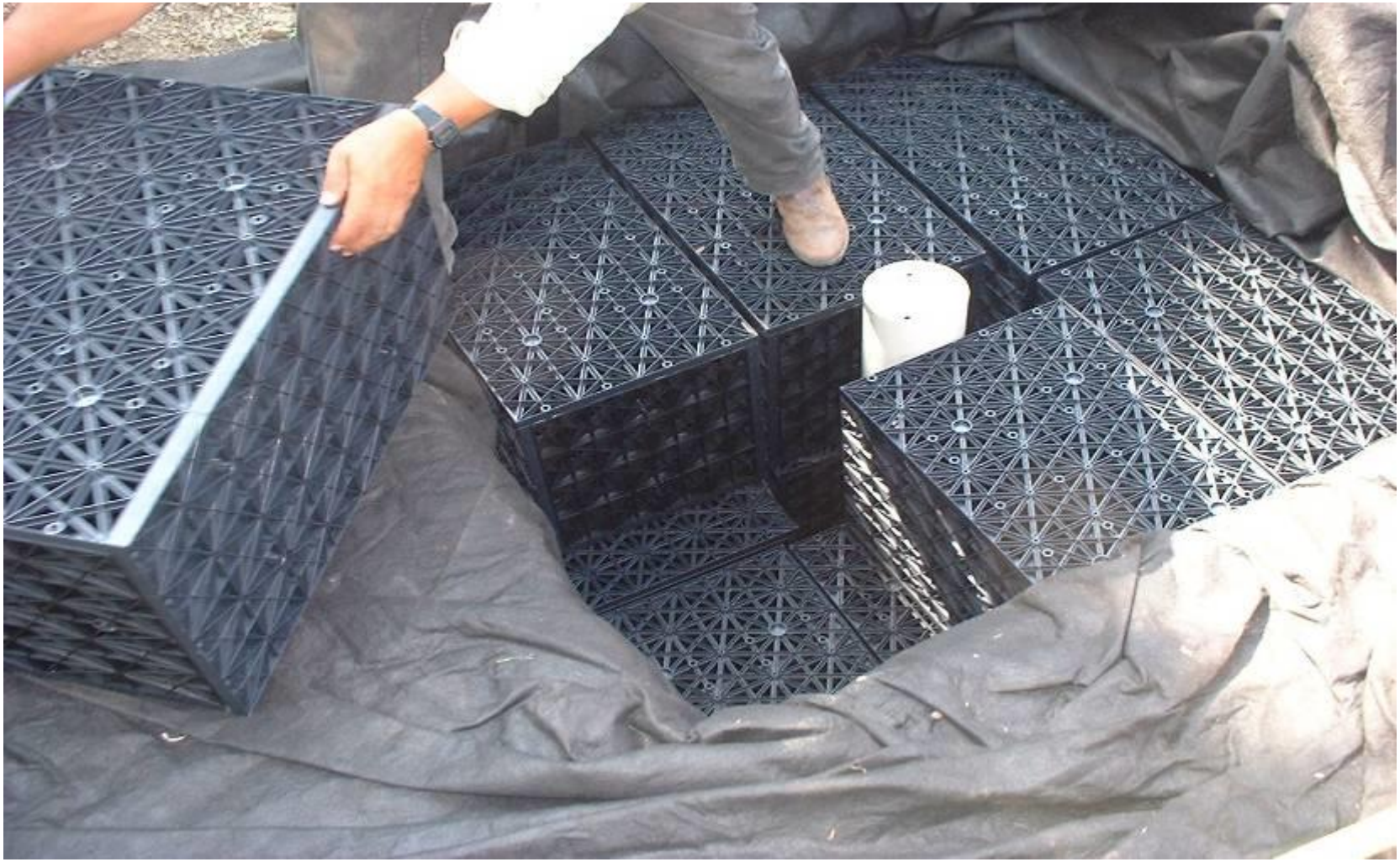
Storm Cell

# Onsite Retention

## Infiltrators

# Cultec Rechargers


# Atlantis tanks



# Eco-Rain Boxes


# Big Projects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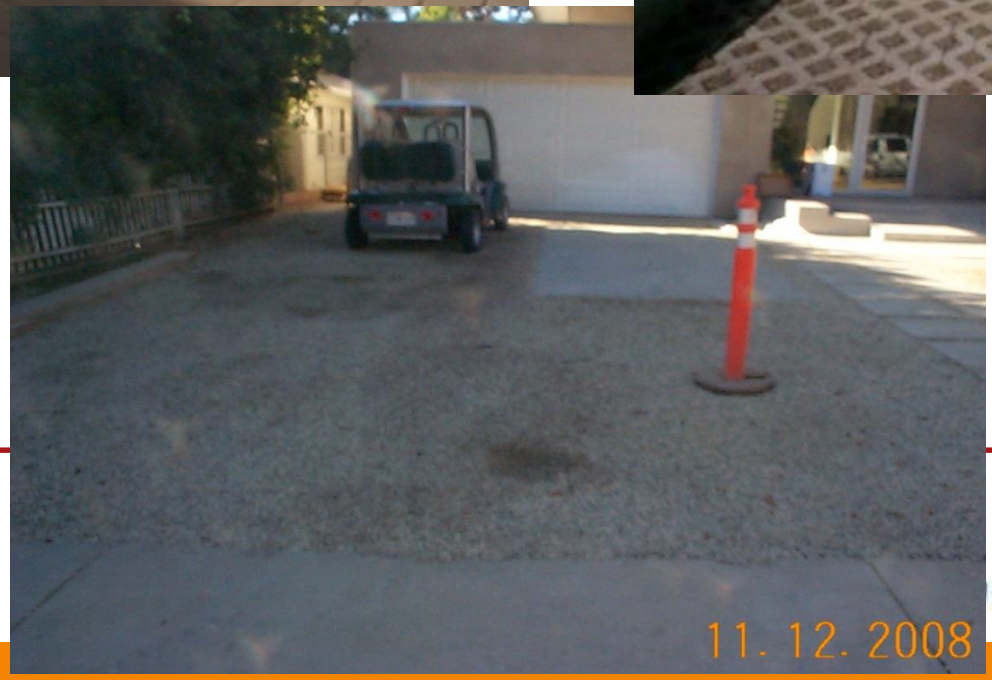
# Driveways and Runoff – drains and paving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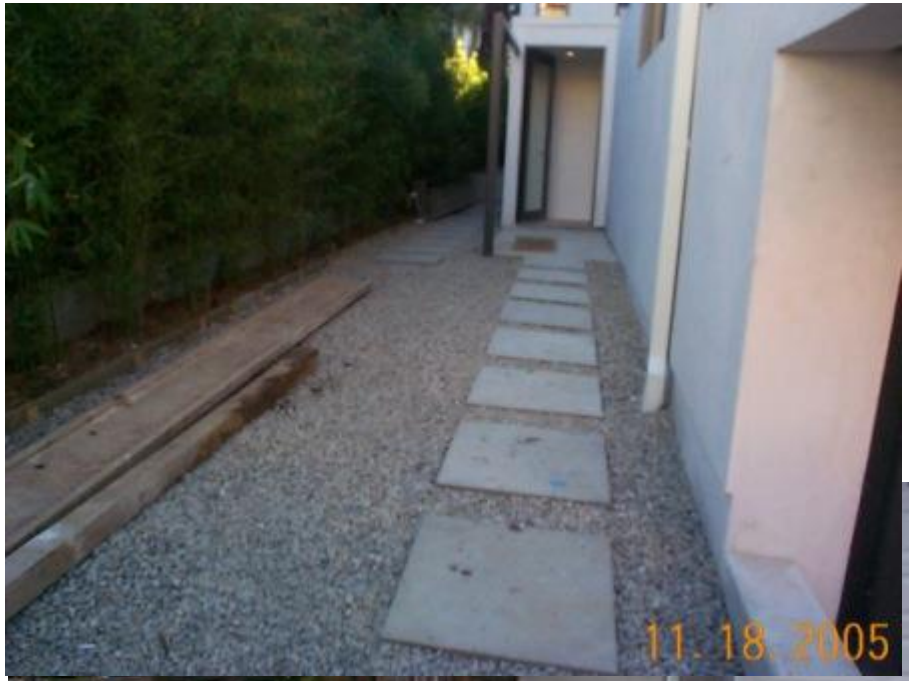
# Driveways, Walkways and Runoff – drains and paving



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# Driveways, Parking and Runoff – permeable paving



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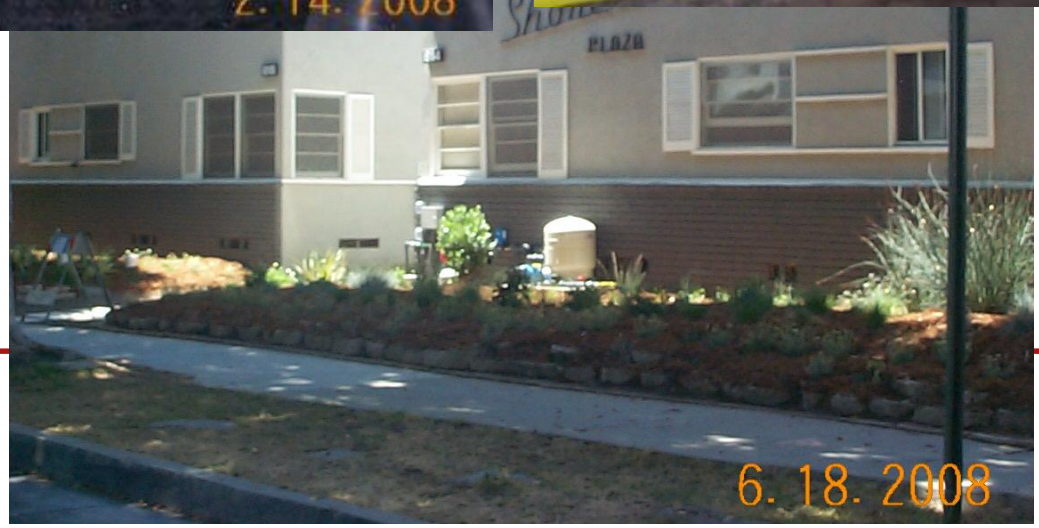
# Rain Harvesting Rebate Program –

## Disconnect, Redirect

# Multi-Family building



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# Multi-Family building

# Single-Family buildings


Rainwater Harvesting

# Single-Family buildings



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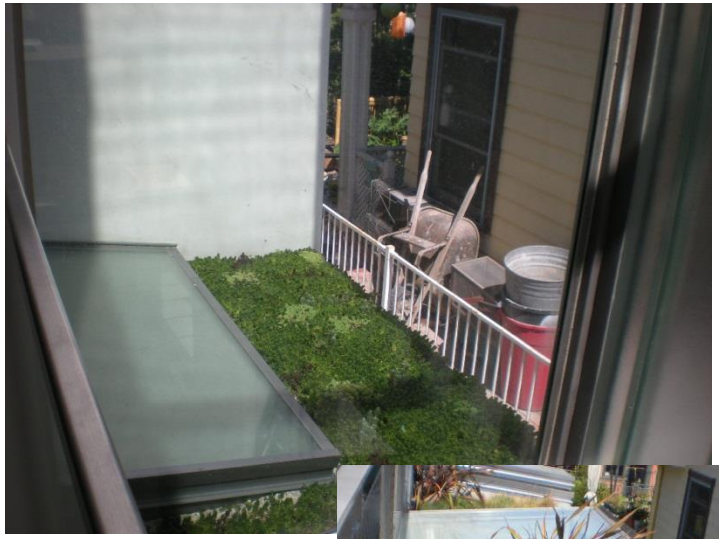
# Single-Family buildings


# Green Roof



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# Green Street – Bicknell Avenue Green Street Project

## BEFORE – Aerial

# Green Street – Bicknell Avenue Green Street Project

## BEFORE



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# Demolition, Parkway Expansion/depressed, Curb cuts

# StormTech Infiltration Chambers

# Permeable Concrete Pour, Curing & Test

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# Catch Basin Filter *(Pre Treatment) – Sub-surface Chamber*


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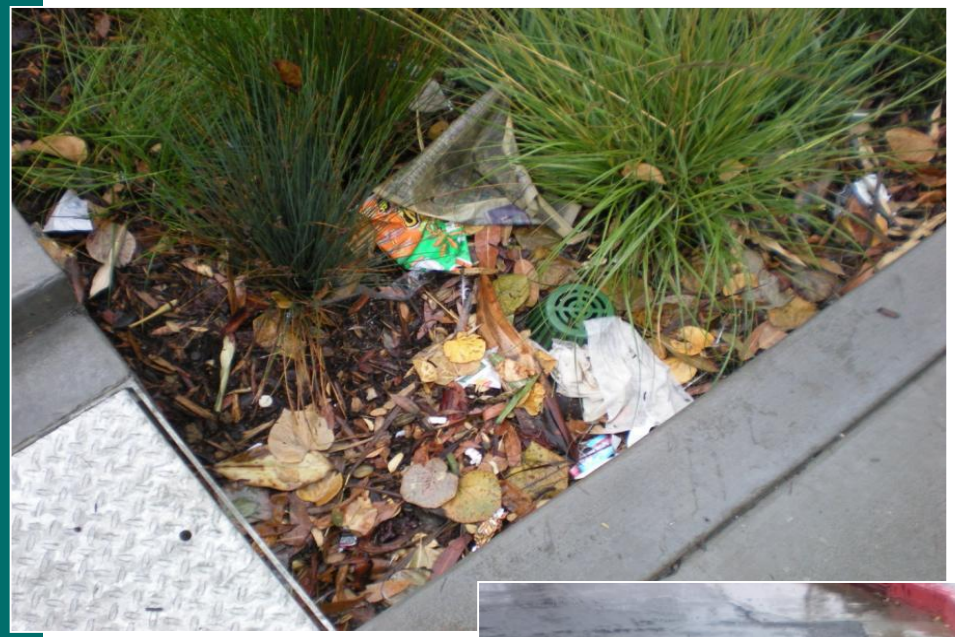
# Parkway Landscaping & Irrigation

# Rain Events



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# Green Street – Bicknell Avenue Green Street Project

## AFTER

# Green Street Projects – 2011: Longfellow: Before

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# Green Street Projects – 2011: Longfellow: Before

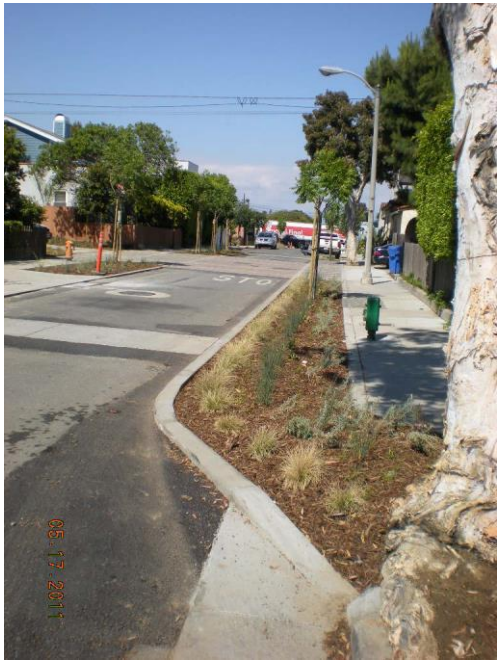
# Green Street Projects – 2011:

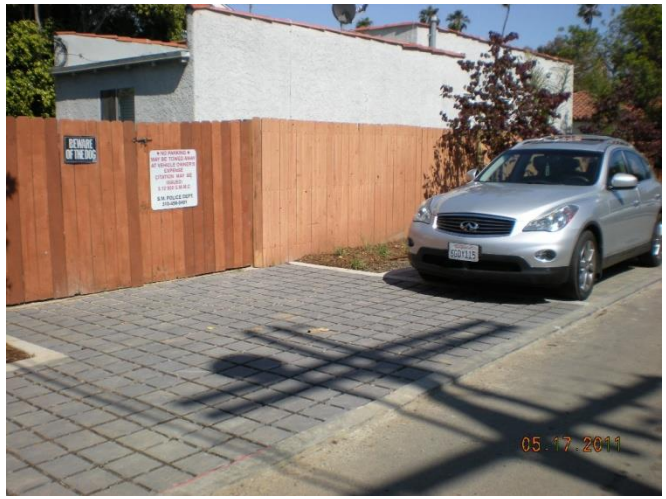
## Longfellow: During Construction

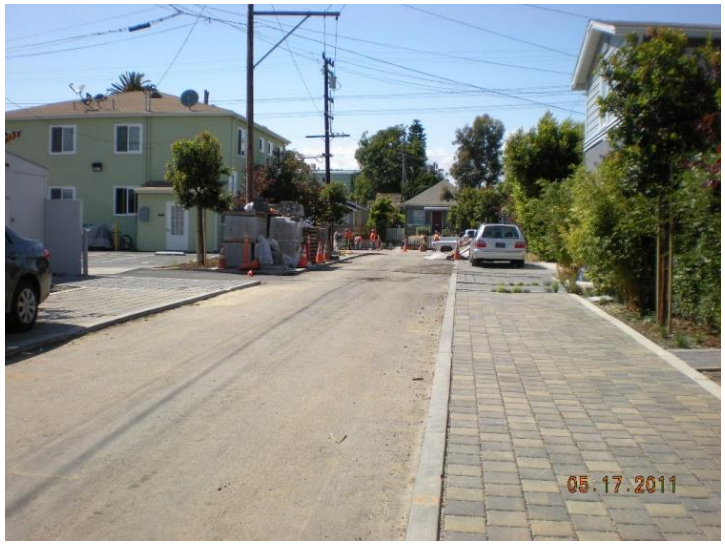



# Green Street Projects – 2011: Longfellow: Completion

Curb Extensions,
Parking Pavers








6,700 gallons per rain event up to ¾”

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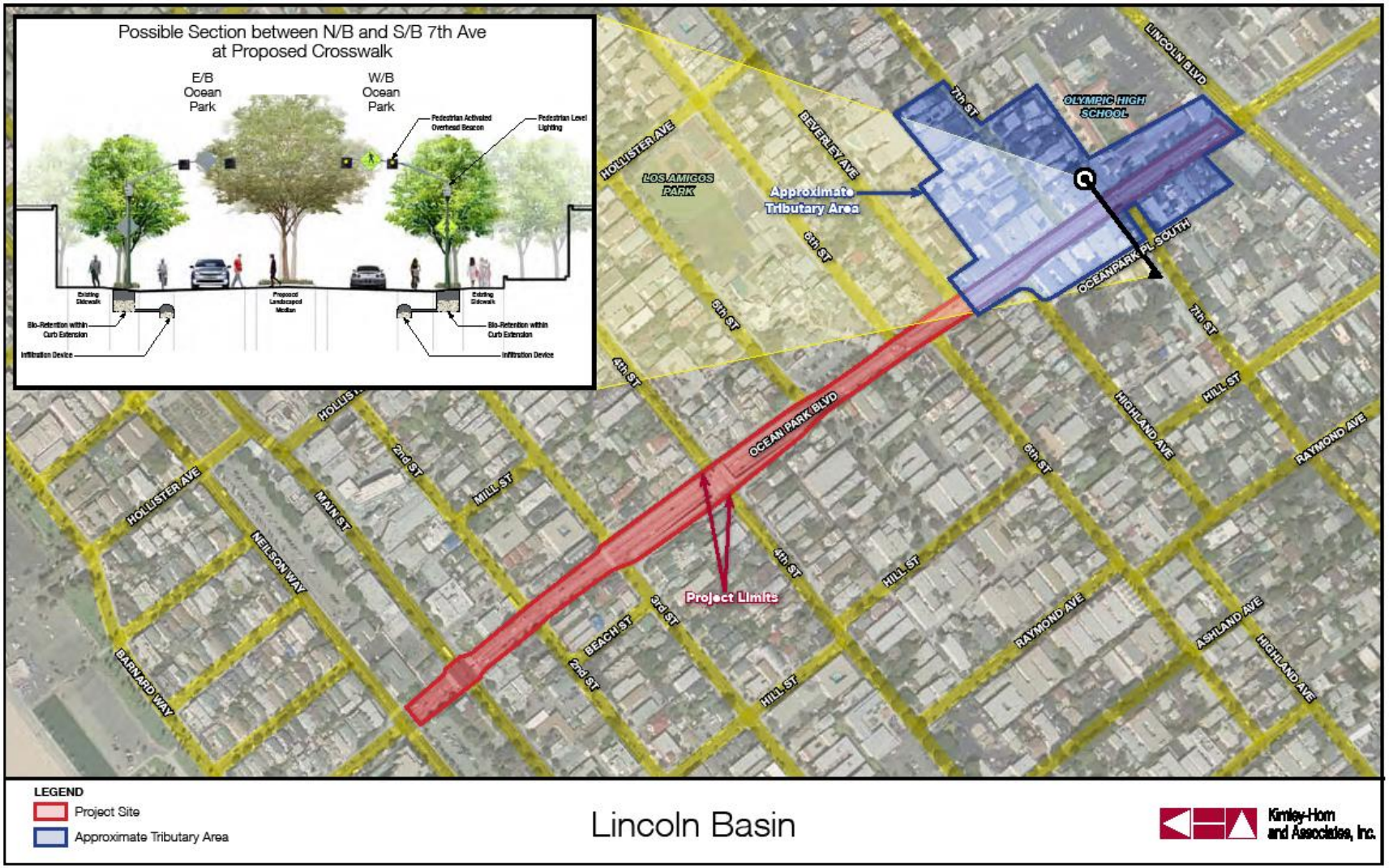
# Ocean Park Blvd Green Street Project



# Ocean Park Blvd. Green Street - Before



# Ocean Park Blvd. Green Street – 2012 Construction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# Ocean Park Blvd. Green Street – 2012 Construction


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# SMURRF

## Santa Monica Urban Runoff Recycling Facility

### Joint Santa Monica-Los Angeles Project

- Reuse a local water resource.
- Keep a pollution source out of Santa Monica Bay.
- Reduce imported water supplies & impacts on other watersheds.
- Open, walk-through facility to educate the public.
- Up to 500,000 gallons/day, ave. is 325,000
- 3% of City's daily water use.
- $12 Million
- $175,000 O&M

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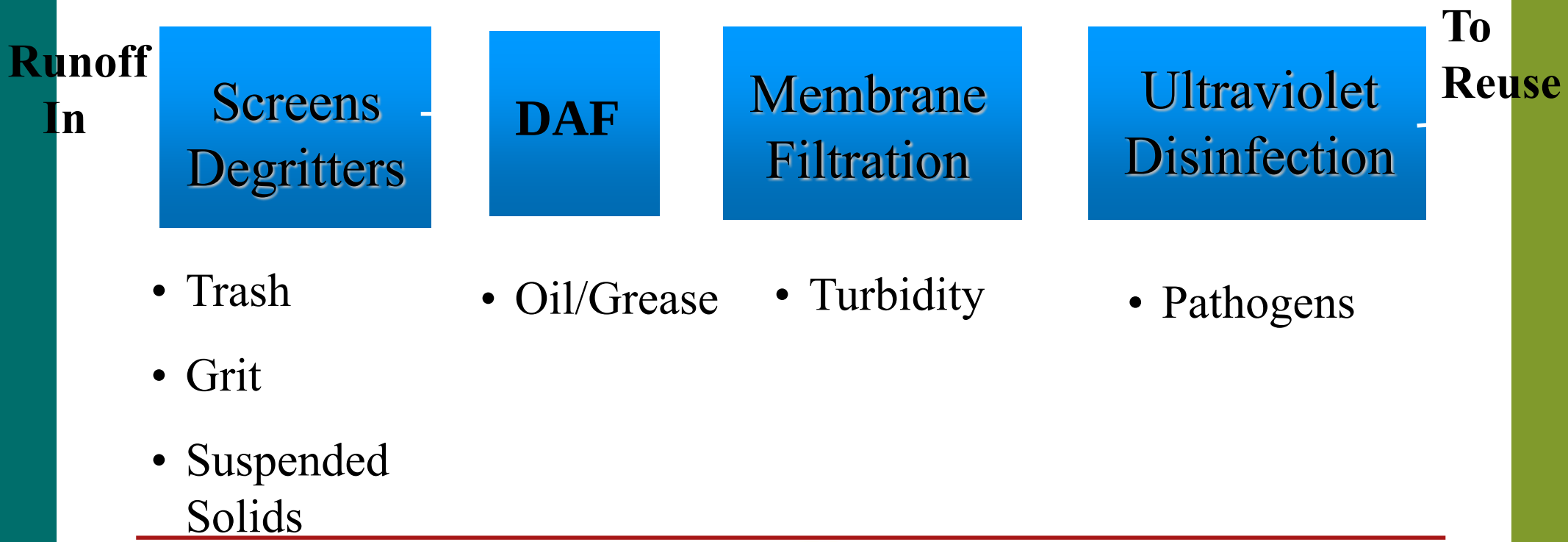
# Recommended Treatment for Reuse with Recycled Water

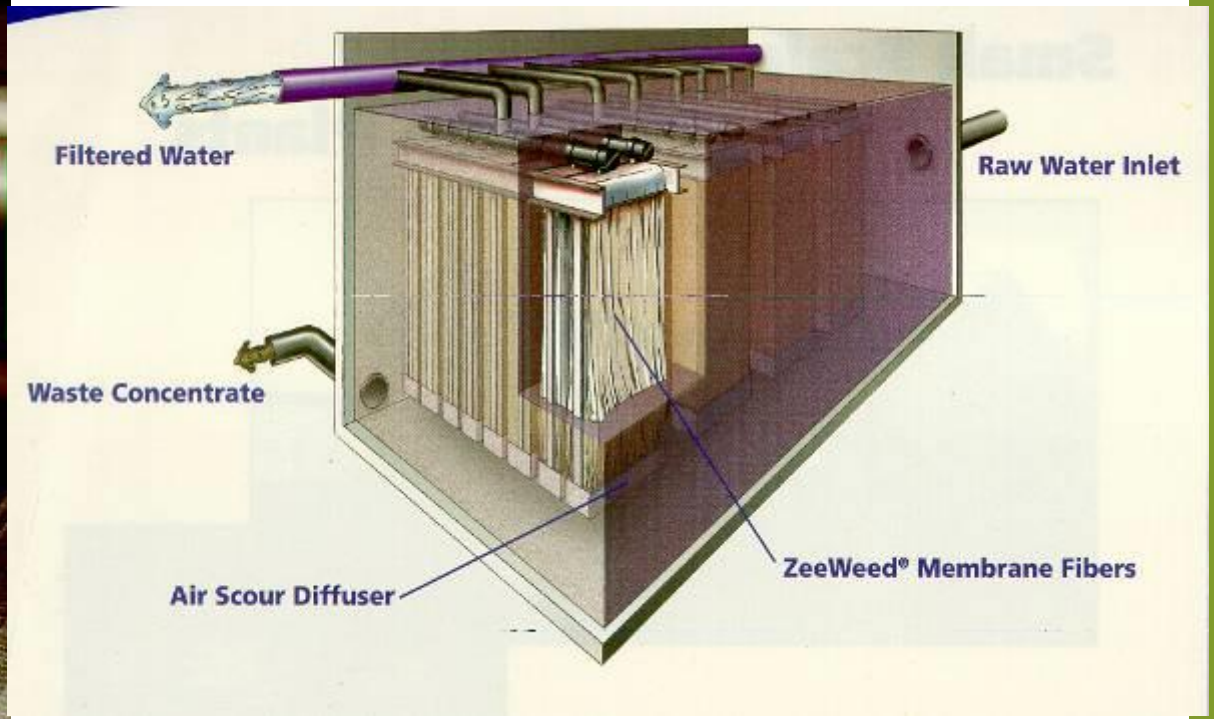


# Rotating Drum Screen

# Grit Chamber

# Dissolved Air Floatation

# Microfiltration

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# UV Radiation Channel

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# Finished Waterfall & Reservoir

# SMURRF Educational Panels


# Artwork

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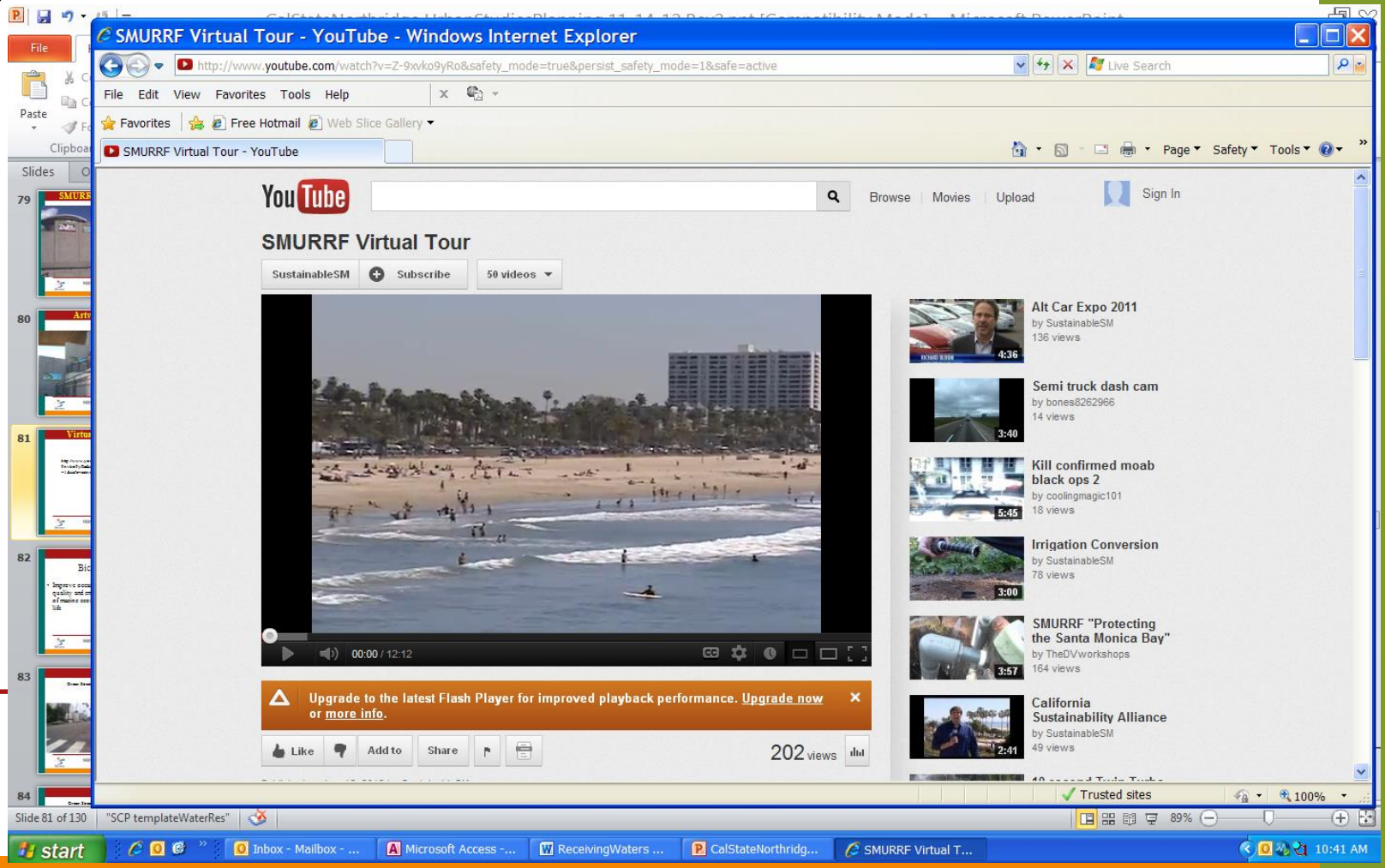
# Virtual Tour of SMURRF

http://www.youtube.com/watch?v=Z-9xvko9yRo&safety_mode=true&persist_safety_mode=1&safe=active

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# Promoting Widespread Implementation

- American Rainwater Catchment Systems Association, www.ARCSA.org is the national organization with expertise in technology, standards and codes to assist in your work.
- Its mission (www.ARCSA.org) is to promote sustainable rainwater harvesting practices to help solve potable, non-potable, stormwater and energy challenges throughout the world.
- Provides workshops for training on harvesting systems.
- Collaborates on writing standards and codes for plumbing, treatment systems and water quality standards, ASPE 63 (rainwater), 78 (stormwater).
- Members include academia, government and business, all critical stakeholders working together to promote this watershed management strategy.
- The City of Santa Monica through its sustainable watershed management program is leading the way, demonstrating solutions.

ARCSA
AMERICAN RAINWATER CATCHMENT SYSTEMS ASSOCIATION

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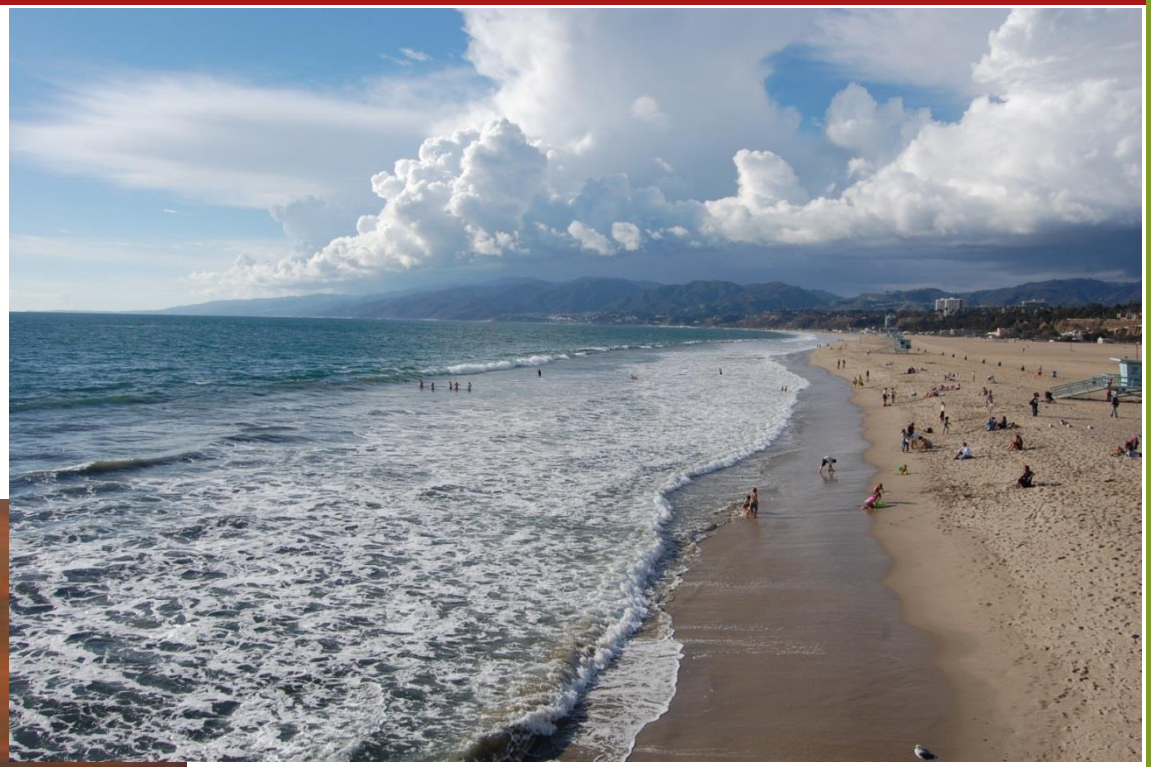
**Thank you, US EPA**




***310.458.8223***
***Neal.Shapiro@smgov.net***
***Sustainablesm.org/runoff***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# *Living River* Series and Conserve 2 Enhance

Photo: Tucson Audubon

## U.S. Environmental Protection Agency Region 9 Webinar

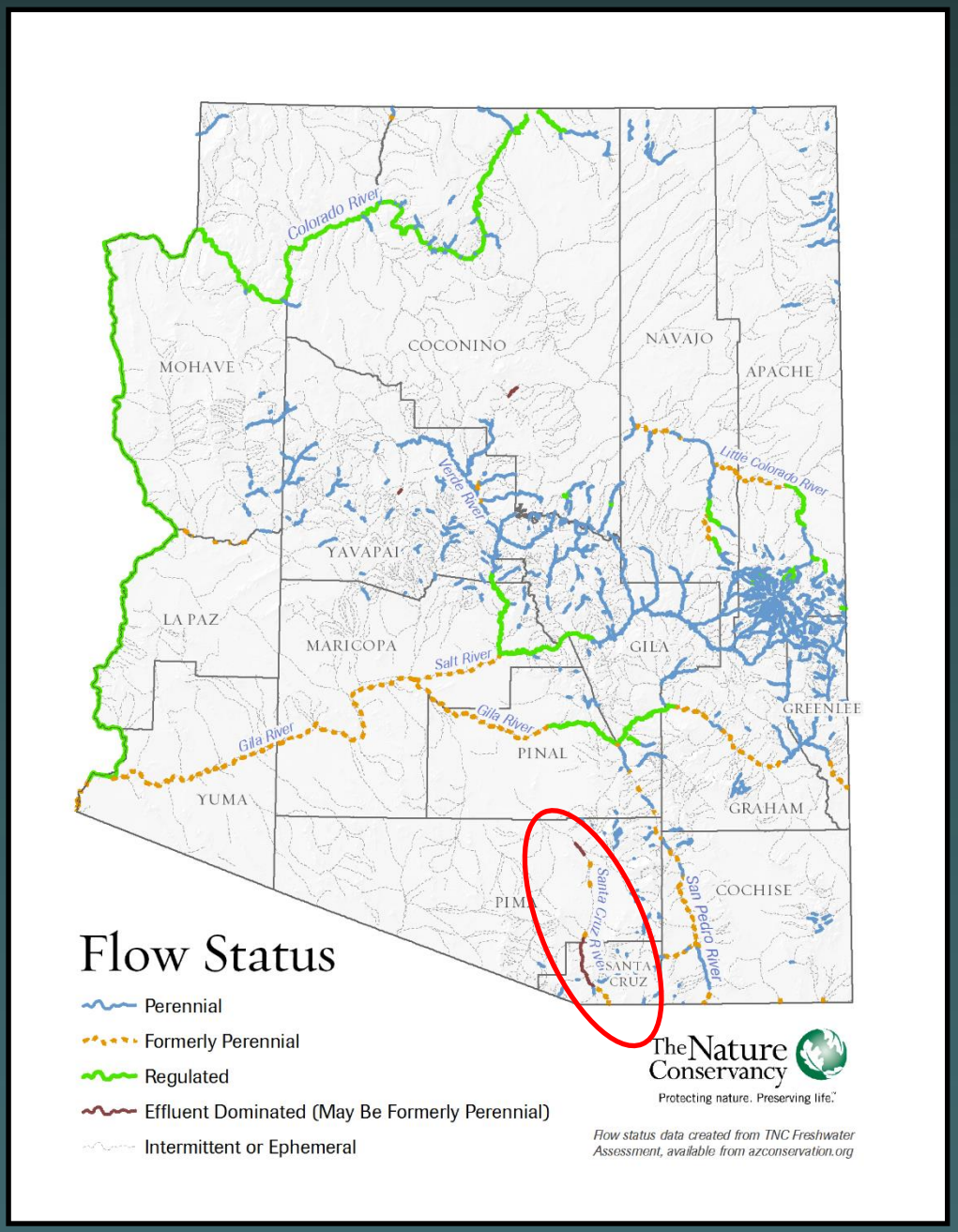
Emily Brott & Claire Zugmeyer, Sonoran Institute

March 24, 2015

*"Running water is something for a Southwesterner to get excited about.*

*It's scarce, it's cool, it's wet, and it creates an oasis of shade, a green retreat from the sun and desiccation of the surrounding country."*

Going Back to Bisbee
Richard Shelton

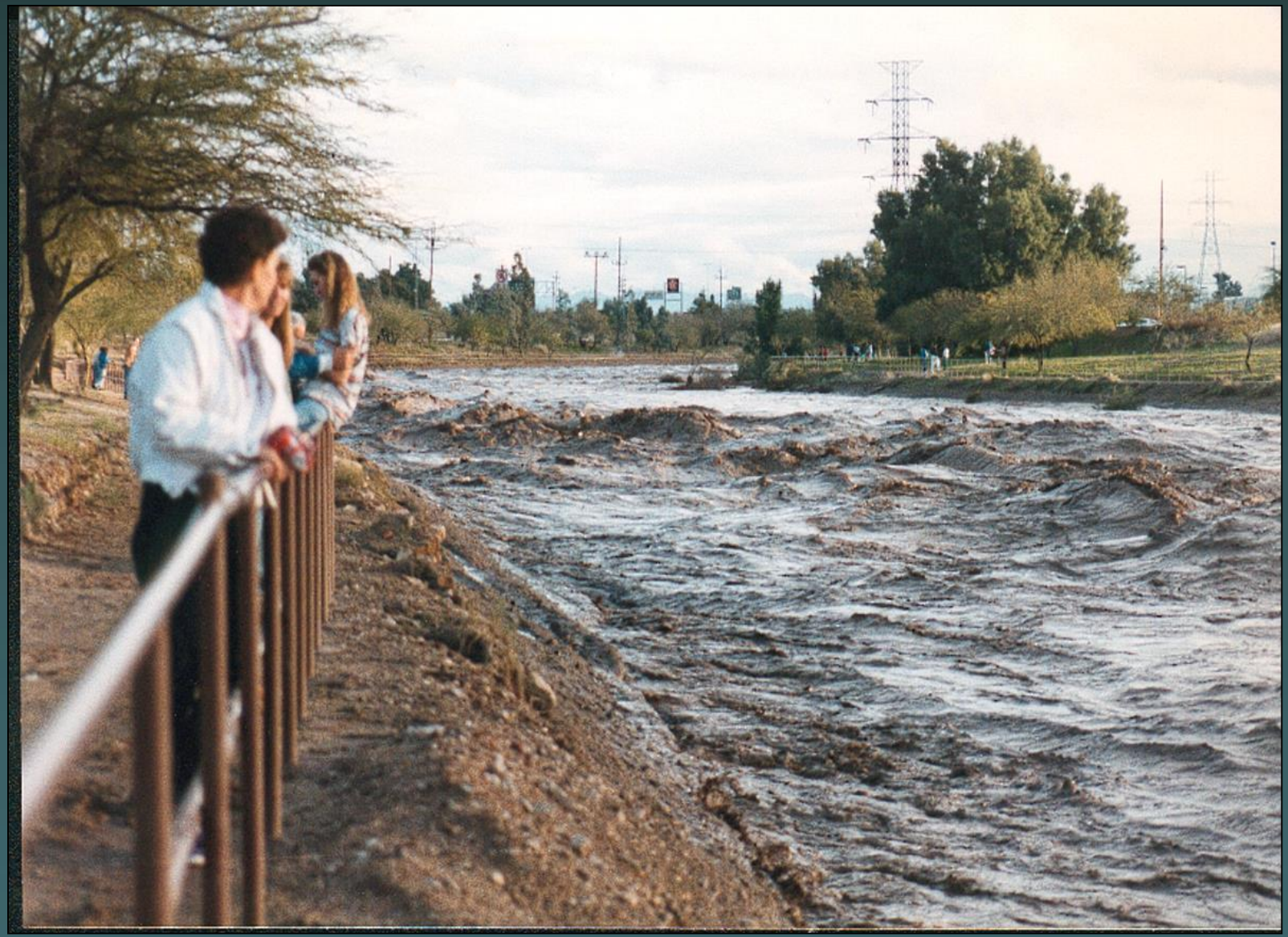



# Importance of Riparian Areas

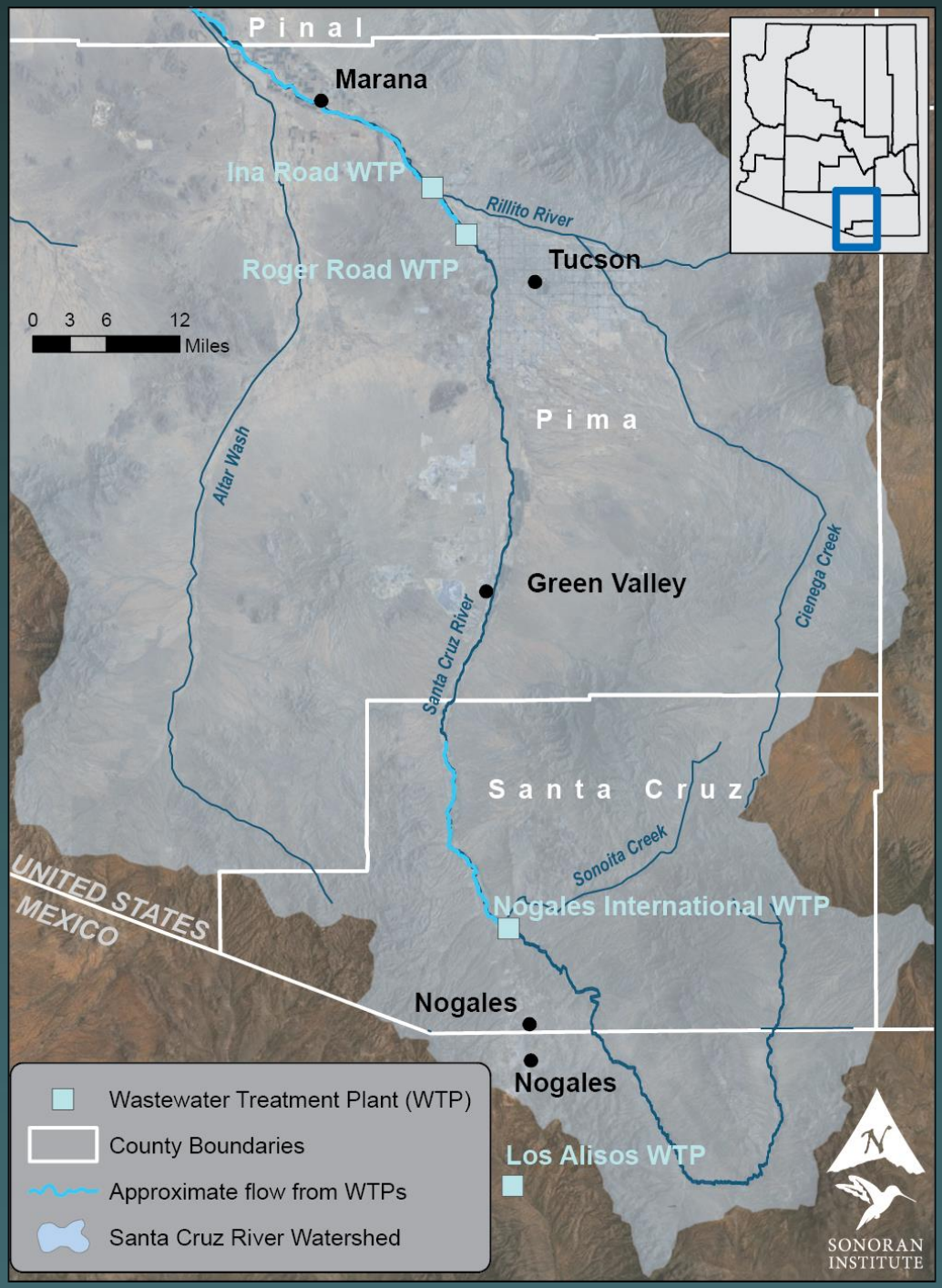
## Context: 12,000 years of Rich History

# Threatened & Endangered Species

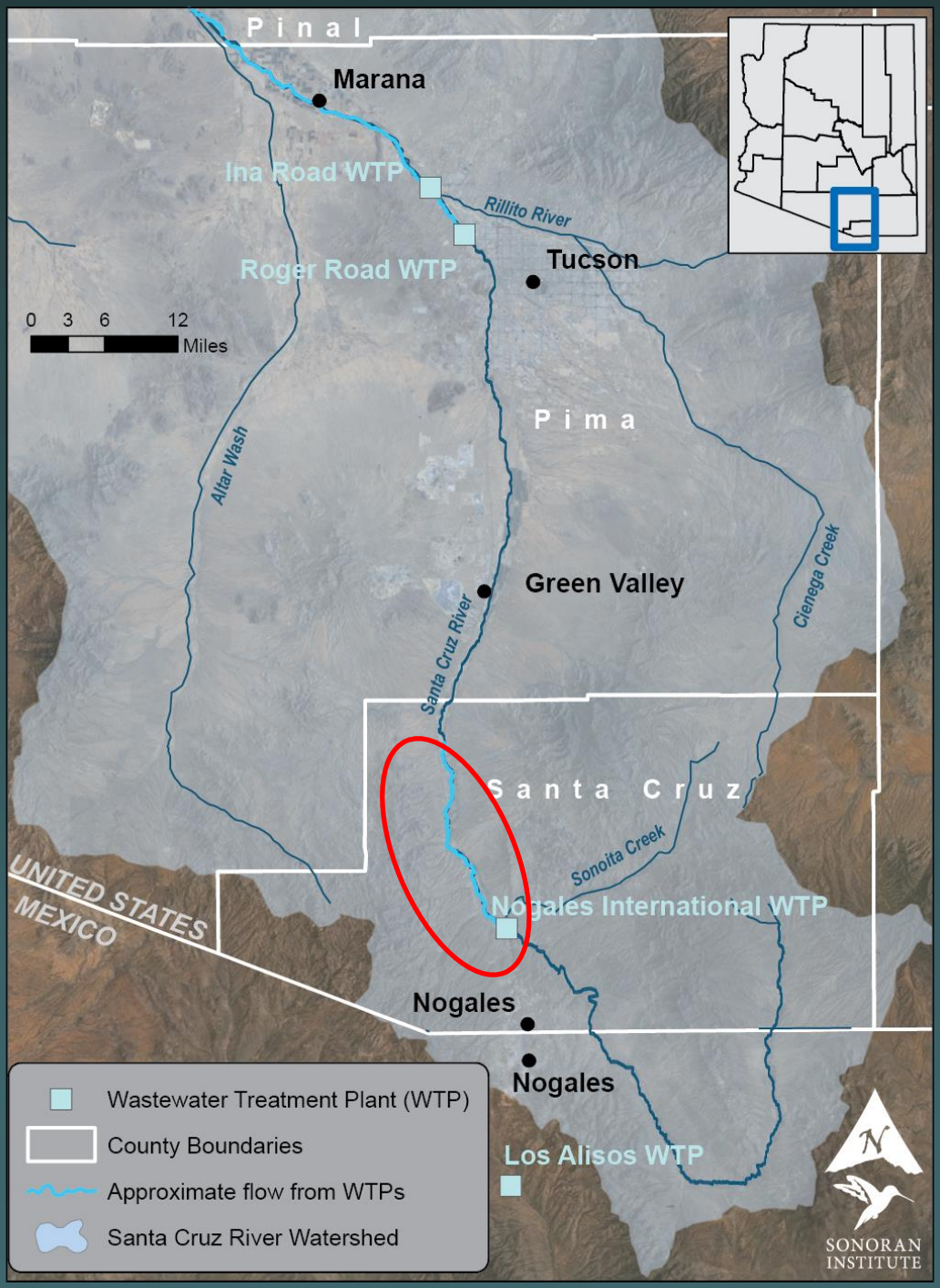
**Demand Far Exceeds Supply**



**Result: Dry Rivers**


Pinal
Marana
Ina Road WTP
Rillito River
Roger Road WTP
Tucson
0 3 6 12
Miles
Pima
Altar Wash
Green Valley
Santa Cruz River
Cienega Creek
Santa Cruz
Sonoita Creek
UNITED STATES
MEXICO
Nogales International WTP
Nogales
Nogales
Los Alisos WTP
Wastewater Treatment Plant (WTP)
County Boundaries
Approximate flow from WTPs
Santa Cruz River Watershed
SONORAN INSTITUTE

**Modern “Headwaters” of Santa Cruz**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Marana
Ina Road WTP
Rillito River
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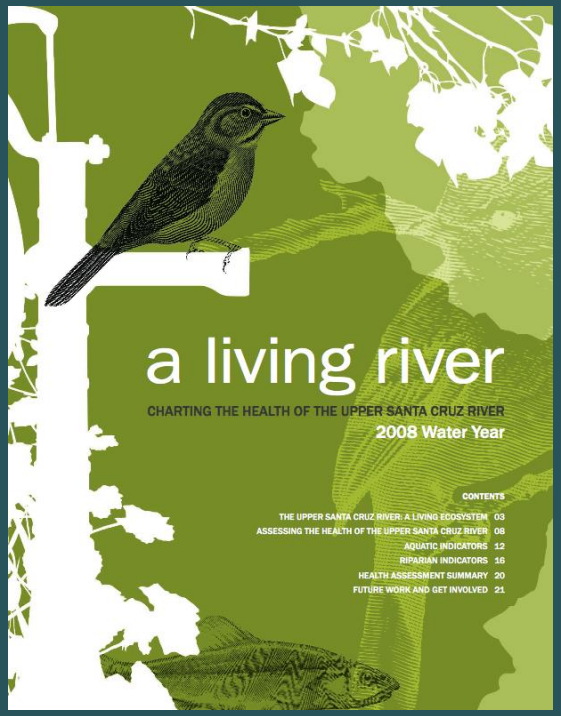
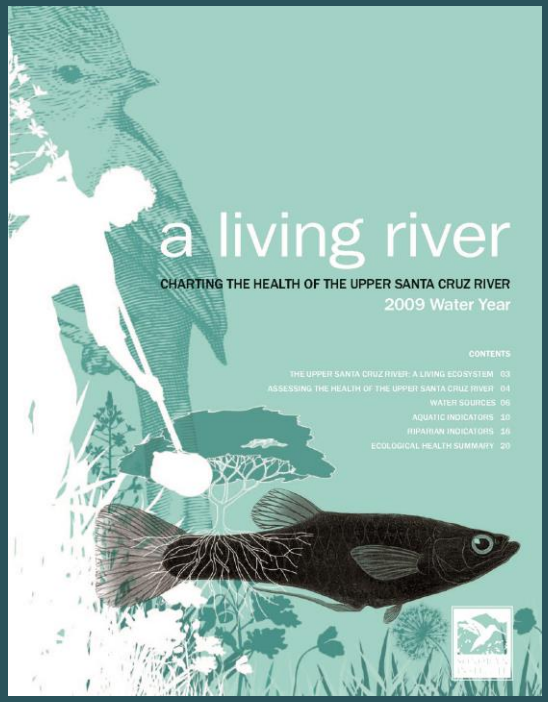
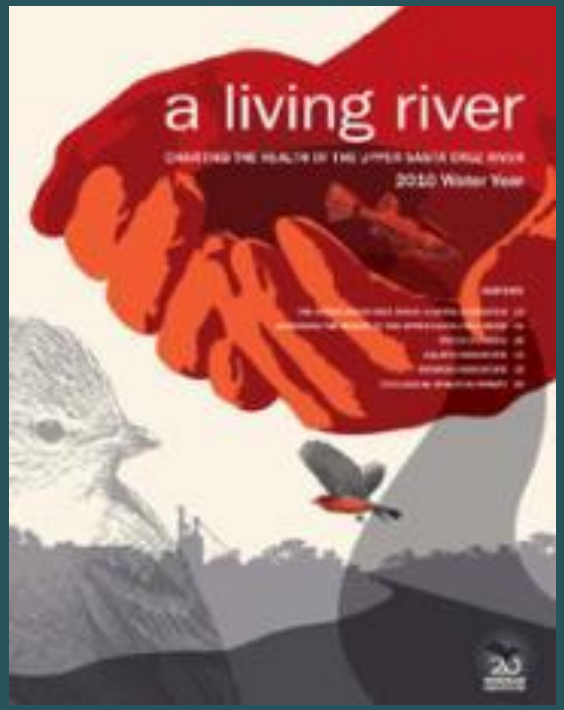
SONORAN INSTITUTE

# Nogales International Wastewater Treatment Plant

# *Living River Report Series*



# *Living River Report Series*

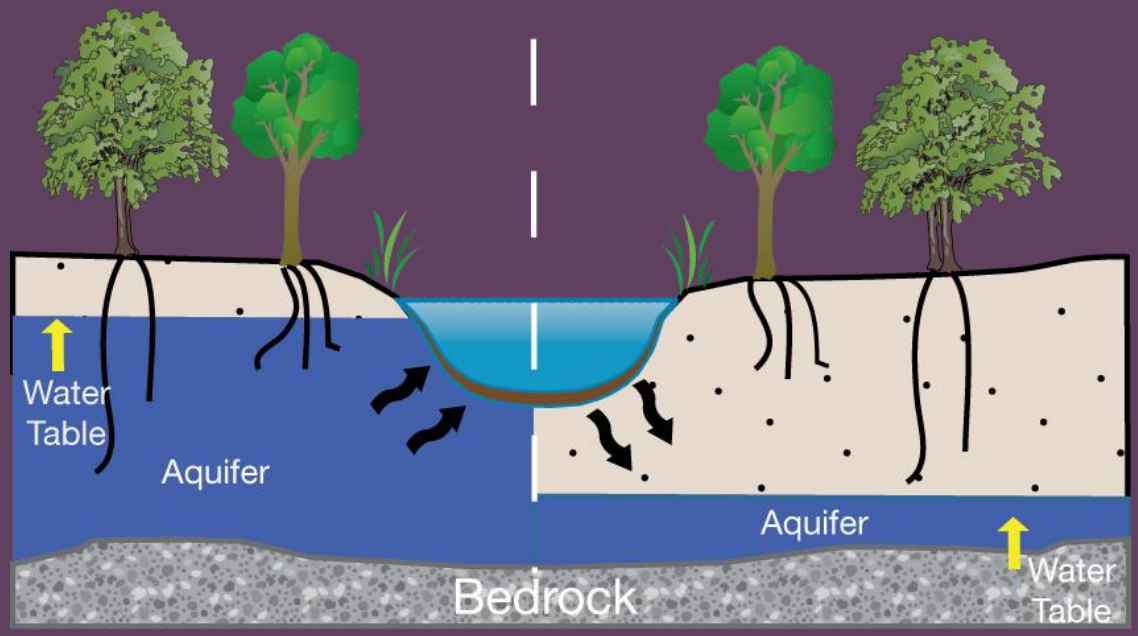
| Category | Indicators and Standards |
|---|---|
| Water Quality | Ammonia: varies with pH |
| | Dissolved oxygen: ≥ 3.0 mg/L |
| | Total phosphorus: < 1 mg/L |
| | E. coli: < 235 CFU/100mL |
| Groundwater | Depth to groundwater: < 5.1 m |
| Aquatic Animals | Fish: 2008 baseline |
| | Aquatic invertebrates: 2008 baseline |
| Landscape | Impervious surfaces: 2009 baseline |
| | Riparian vegetation: 2006 baseline |

# *Living River Report Series – Upper Basin*

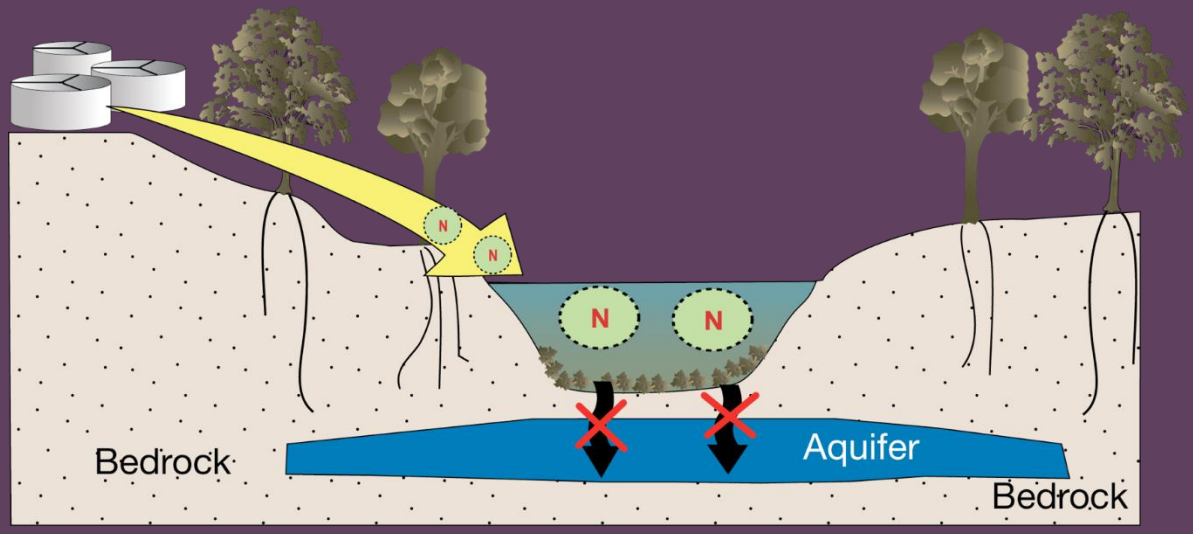
- **Notable improvements:**
  - Fish returning!
  - Water quality

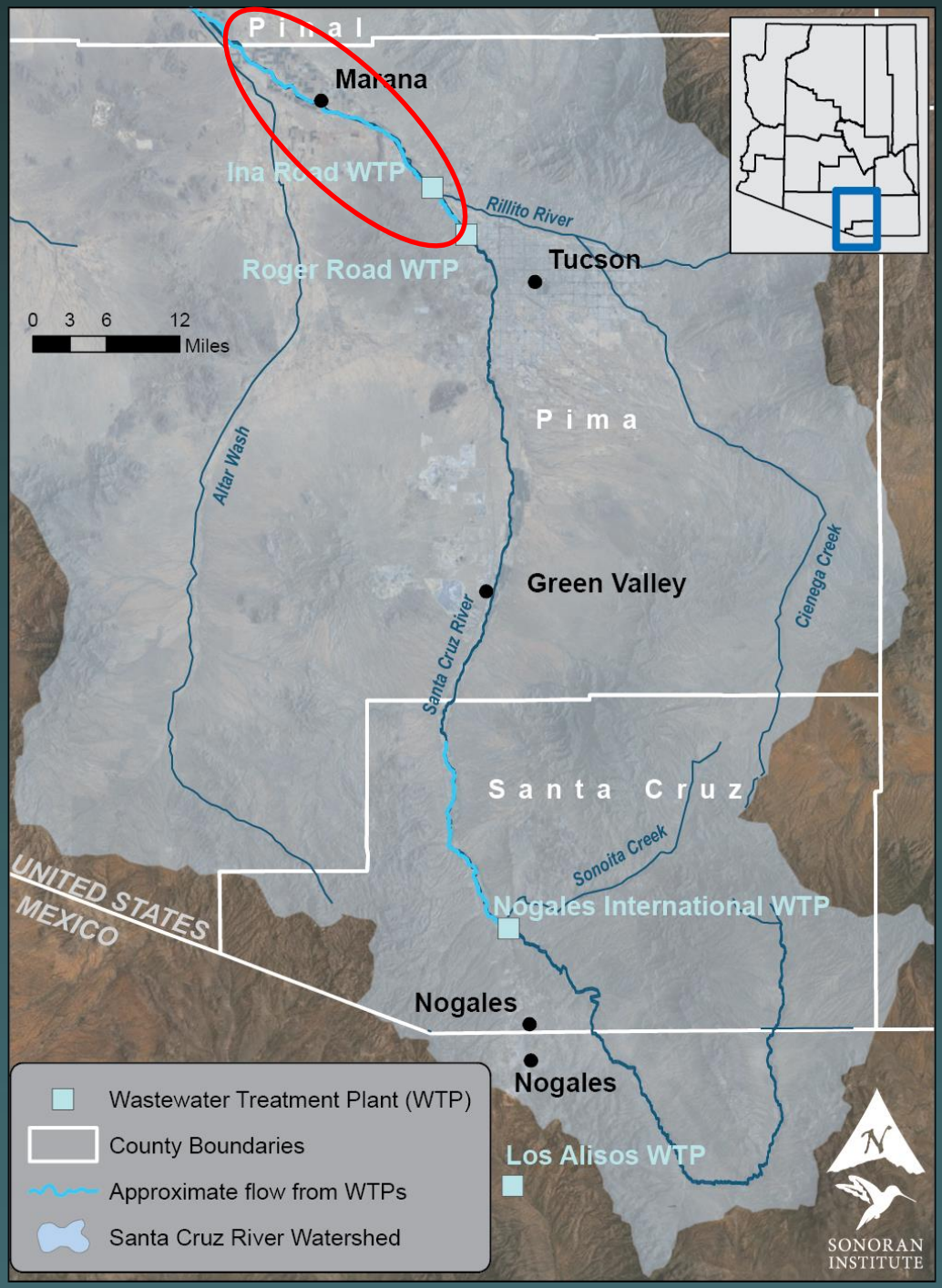
- **Persistent concerns:**
  - Water flow/quantity
  - E Coli
  - Heavy metals

Healthy Hydrologic Function 1980s & 1990s




Perfect Storm Conditions 2002 - 2005

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County Boundaries
Approximate flow from WTPs
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N
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# *Living River Report Series – Lower Basin*

PIMA COUNTY

EPA

# a living river

CHARTING WETLAND CONDITIONS OF THE LOWER SANTA CRUZ RIVER

2013 Water Year

CONTENTS



PIMA COUNTY

## ASSESSING WETLAND CONDITIONS

The *Living River* report evaluates conditions of the Lower Santa Cruz River using 16 indicators (see diagram) organized into six categories: *flow extent, water quality, sediment transport, aquatic wildlife, riparian vegetation,* and *social impacts*. The indicators relate to the conditions in the river channel and in the adjacent riparian areas, the areas next to and affected by the river. Other important characteristics are being informally tracked. These are discussed throughout the report and include nutrient pollution, birds, amphibians and reptiles, and recreation.

The purpose of the *Living River* series is to monitor and report on the wetland and riparian conditions at various intervals downstream of the effluent discharge points. As the effluent flows downstream, it impacts and is impacted by the natural conditions of soils, vegetation, and surrounding environment created by the effluent. The selected indicators will be used to study these interactions. Guidelines for evaluation of these indicators were developed as described in the following paragraph.

Data collected by Pima County and by other organizations are evaluated for this report. Most water quality indicators are compared to standards set by the Arizona Department of Environmental Quality (ADEQ) that define water quality goals for streams and are designed to protect wildlife. For some standards, ADEQ defines goals for streams whose waters are dominated by effluent. However, for indicators where there are no such standards, data are evaluated with reference values established by historical data or other sources. For indicators without a clear reference value or standard, the 2013 *Living River* assessment becomes the baseline for tracking future change. Additional information about historical conditions along the river is summarized in *Historical Conditions of the Effluent-Dependent Lower Santa Cruz River*, available online at **www.tiny.cc/lscr**.

The following pages present the data collected in the 2013 water year (October 1, 2012–September 30, 2013), prior to reclamation facility upgrades. For the purposes of this report, the 23-mile stretch of river is divided into three sections, or reaches: Three Rivers, Cortaro Narrows, and Marana Flats. These reaches differ in geology, hydrology, and adjacent land use. To review all the data in more detail and see additional charts from the 2013 water year, please visit the Sonoran Institute website at **www.tiny.cc/lscr13**.

**IMPORTANT NOTE:** Facility upgrades at the Tres Rios WRF came online in phases between Fall 2012 and Fall 2013. However, the Agua Nueva WRF upgrades did not come online until December 2013. Therefore, the cumulative effect of all the upgrades is not reflected in the baseline information in this report. As this report was sent to the press, casual observation of the river suggests that the upgrades will significantly impact wetland conditions and flows in the Lower Santa Cruz River.

Riparian areas are the areas next to and affected by the water in wetlands, rivers, and desert washes. Wetlands are places where water saturates the soil, thereby shaping what can grow there. Riparian areas and wetlands are extraordinarily rare in the desert. They produce abundant wildlife, and people highly value them for recreation and relief from the heat.

Santa Cruz River near Ina Road, 2014

| CATEGORY | PURPOSE | INDICATORS |
|---|---|---|
| FLOW EXTENT | General measure of water flowing in and out of the system, recharge, and available aquatic habitat. | • Miles of flow in each reach<br>• Flow at Trico Road |
| SEDIMENT TRANSPORT | Measure of solid particles moving through the system, which can impact habitat and conditions for aquatic plants and animals. | • Total suspended solids<br>• Turbidity<br>• Percent fines |
| WATER QUALITY | Measure of chemical conditions necessary for sustaining the river's animal and plant communities. | • Total dissolved solids<br>• Ammonia<br>• Dissolved oxygen<br>• Biochemical oxygen demand<br>• Metals |
| AQUATIC WILDLIFE | Direct measure of river's wildlife which integrate many factors of the surrounding environment. | • Fish<br>• Aquatic invertebrates |
| RIPARIAN VEGETATION | Direct measure of river's plant communities which reflect changes in water quantity and quality. | • Wetland indicator status<br>• Nitrogen affinity score<br>• Riparian tree cover |
| SOCIAL IMPACTS | Measure of aesthetic factors that directly impact people living or recreating along the river. | • Odor at reclamation facilities |

# *Living River Report Series – Lower Basin*


## SWEETWATER WETLANDS

A portion of the effluent from Agua Nueva WRF is reused to create the Sweetwater Wetlands. This water-rich park provides urban wildlife habitat for many native species including dragonflies, raccoons, hawks, bobcats, and dozens of others that make the wetlands their full- or part-time home. For example, this is a very popular birding destination (see birds on page 15). The wetlands are also an outdoor classroom, providing a natural setting for teaching students of all ages about the rich ecosystems supported by water in arid environments and the importance of water resource management.

After flowing through the wetlands, water that doesn't evaporate or get used by wetland plants drains into adjacent recharge ponds where it percolates down through soil, getting additional cleaning while replenishing the local aquifer. This water is then pumped during periods of high water demand and distributed by the reclaimed water system for reuse in Tucson's golf courses, parks, schools, and other large turf irrigation areas.

## THE RECLAMATION PROCESS

Over the years, the reclamation facilities along the Lower Santa Cruz River have received national awards for meeting over 70 regulatory requirements concerning the release of effluent into the river. Wastewater reclamation is a multi-step process to treat sewer discharge. This process includes removing solids, digesting organic wastes, and reducing nutrient levels. The water is then clarified and disinfected prior to being released into the river. After the data were gathered for this baseline report, Pima County completed major modifications to both reclamation facilities along the river. The goals of the upgrades included:

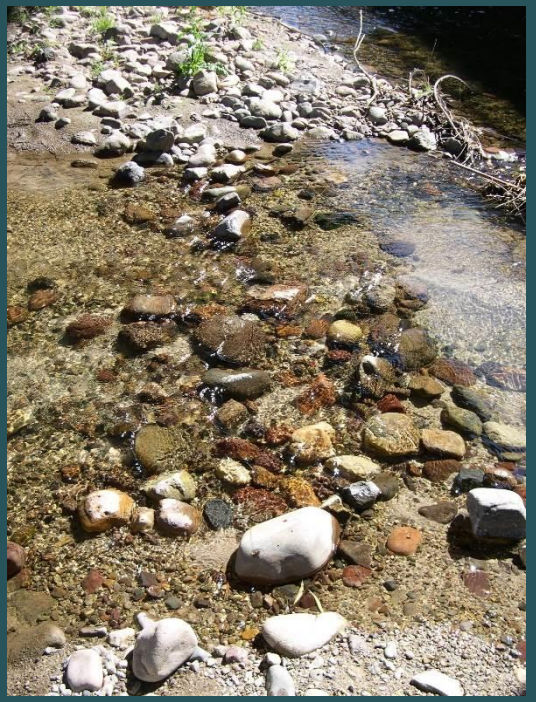
- Improving the quality of the effluent released into the river, primarily by reducing nutrient levels and solids.
- Incorporating odor control technology to prevent odors from affecting the neighboring communities.

# Wetland Health Indicators

- Wetland Vegetation
- Odor
- Water Quality
- Flow Extent
- Sediment
- Wildlife

# Water Clarity and Odor

Before

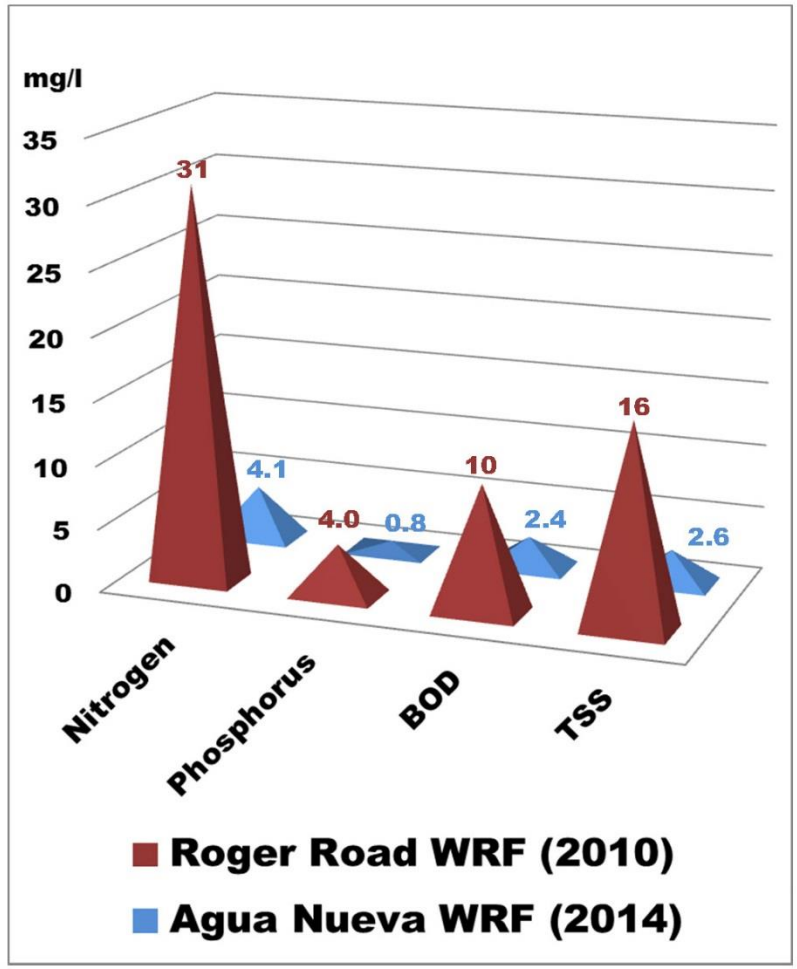


After

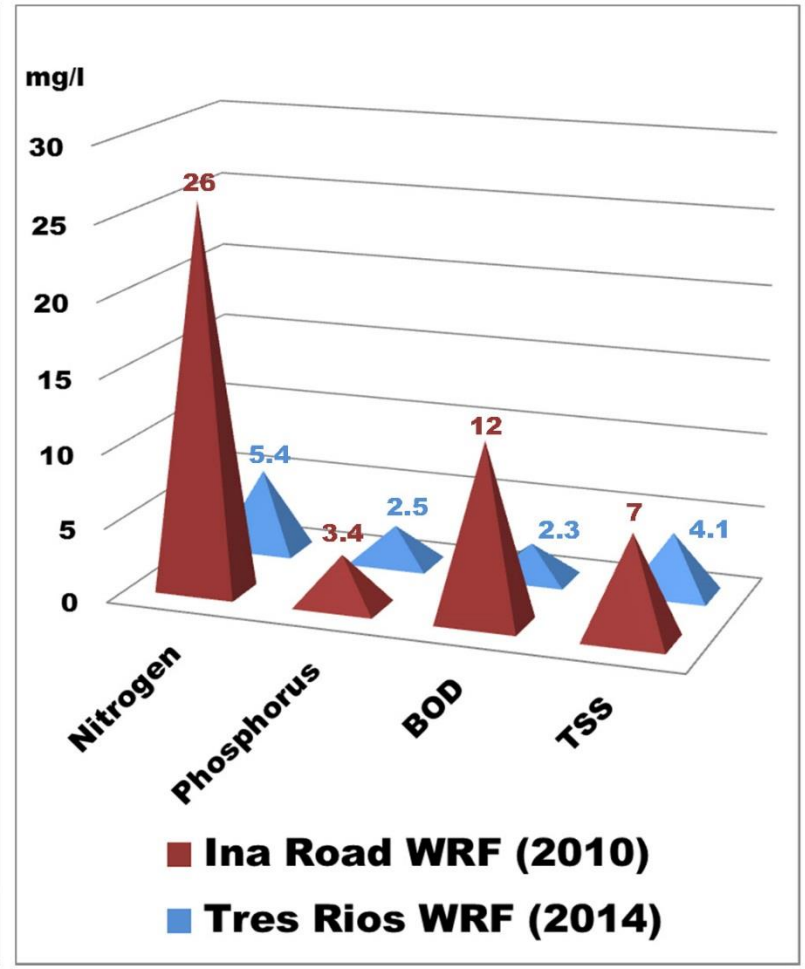
Photos-Pima County

# Effluent Quality Comparison

## Effluent Quality before and after Agua Nueva WRF startup



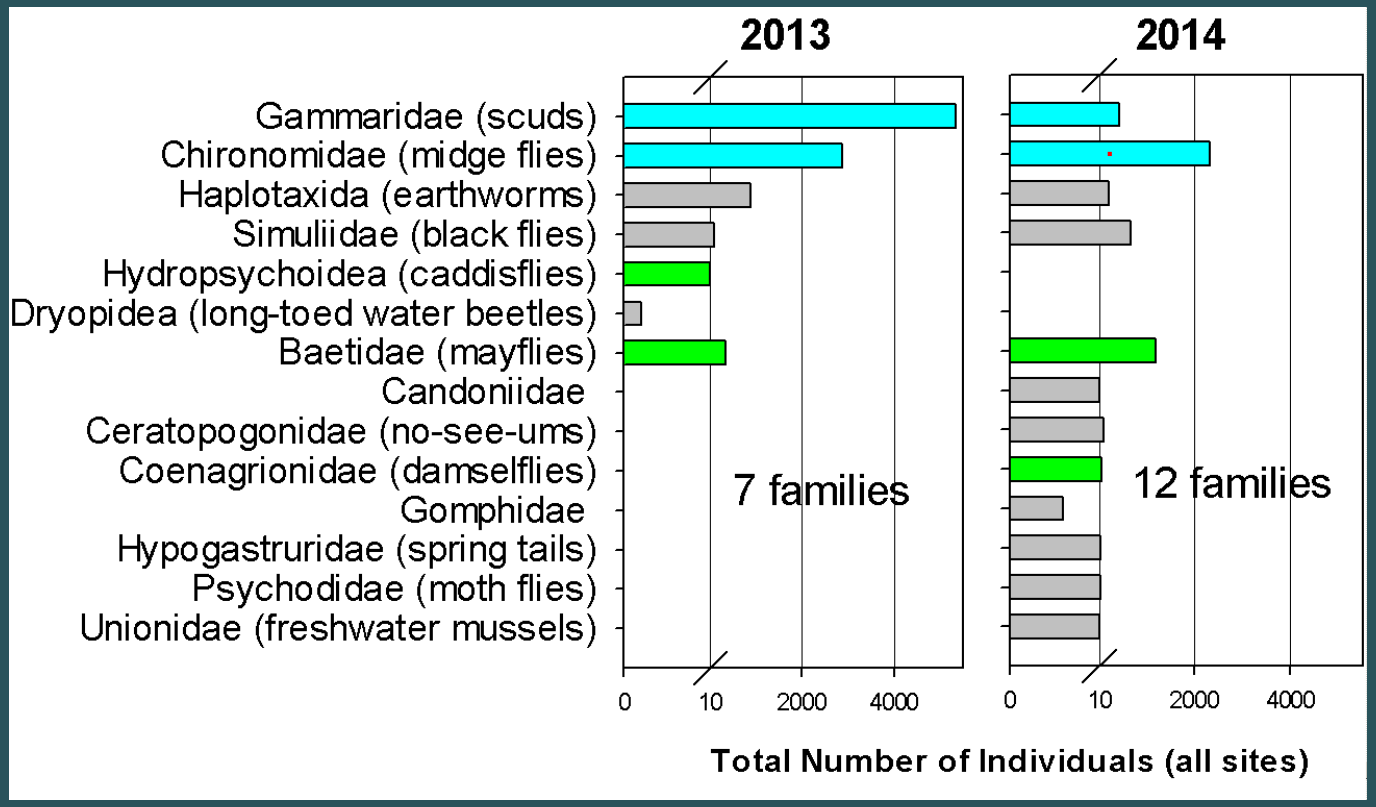

## Effluent Quality before and after Tres Rios WRF upgrade



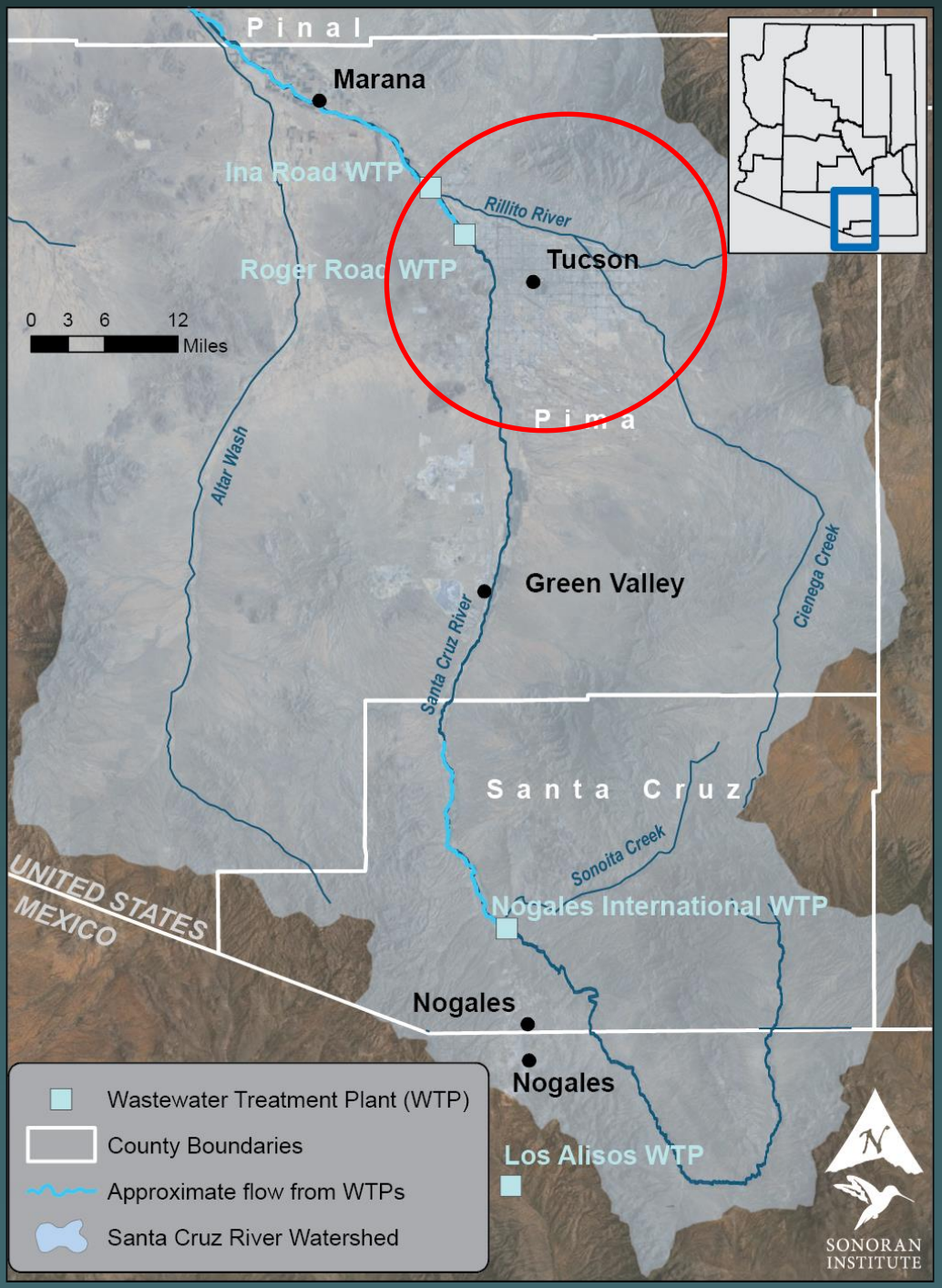
# Before: ↑ Scuds, Snails, Leeches and Midges

Photos- Patti Spindler

# After: ↑ Mayflies and Damselflies, ↑ Diversity



# *Living River Outreach and Education*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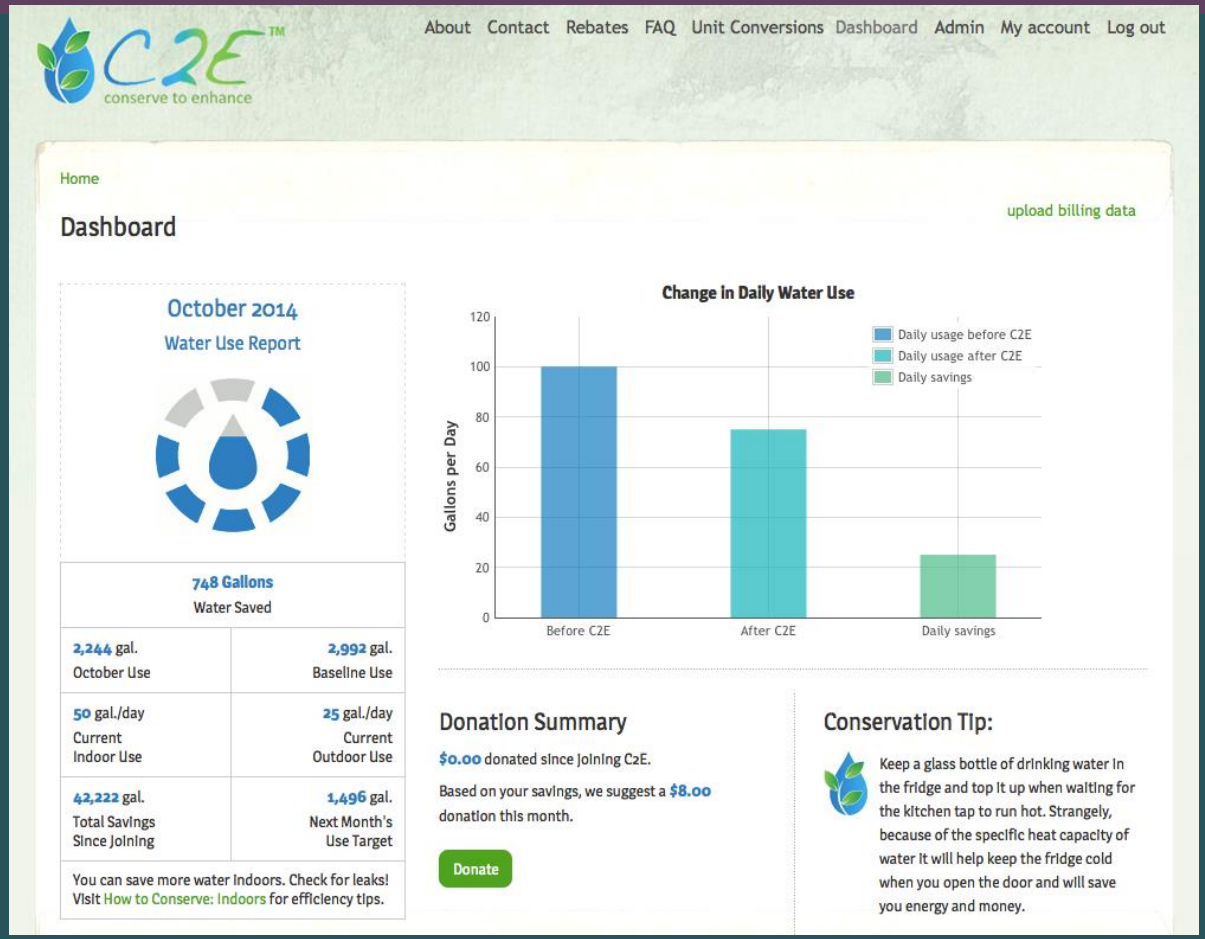
# *Tucson Conserve 2 Enhance*

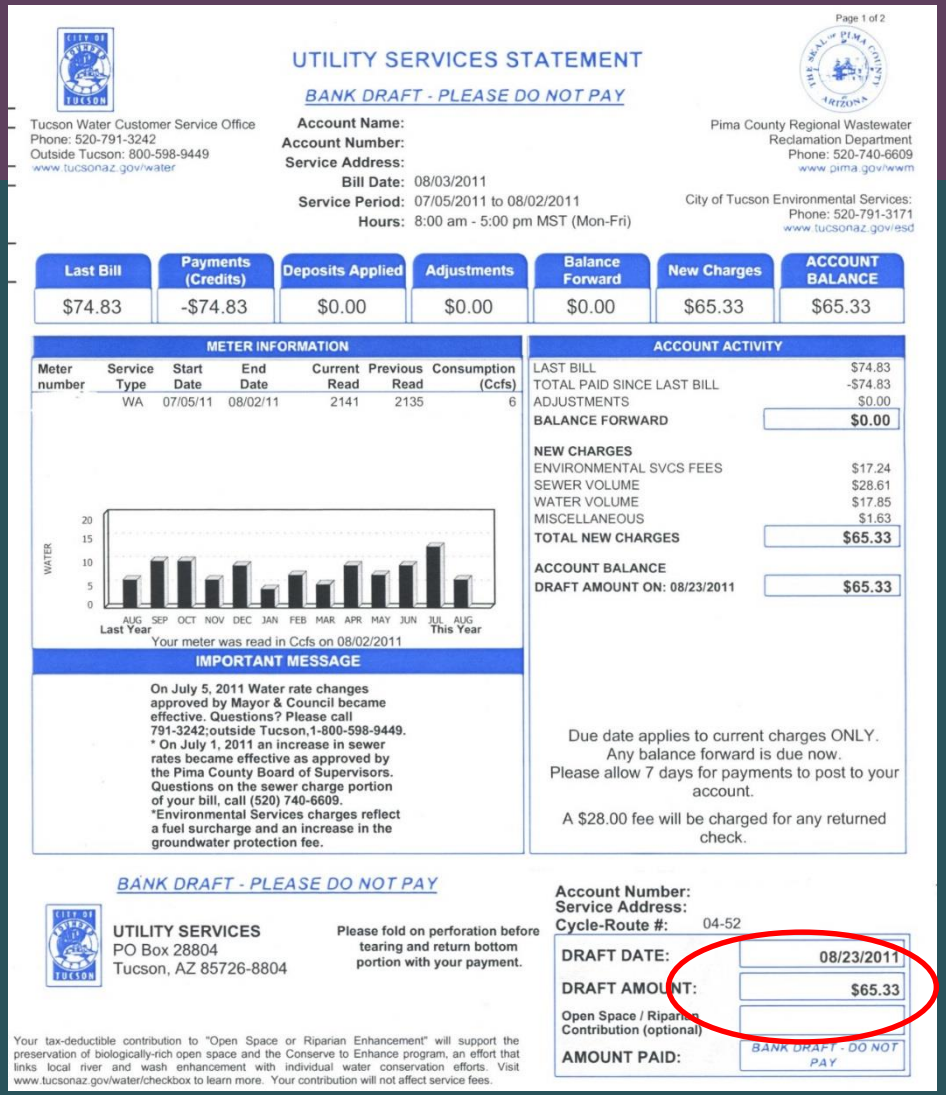
C2E™
conserve to enhance

# *Tucson C2E Launched 2011*




# *Track your Water Savings & Donate On-line or Via Water Bill*

C2E™
conserve to enhance



Page 1 of 2

## UTILITY SERVICES STATEMENT

BANK DRAFT - PLEASE DO NOT PAY

Tucson Water Customer Service Office
Phone: 520-791-3242
Outside Tucson: 800-598-9449
www.tucsonaz.gov/water

Account Name:
Account Number:
Service Address:
Bill Date: 08/03/2011
Service Period: 07/05/2011 to 08/02/2011
Hours: 8:00 am - 5:00 pm MST (Mon-Fri)

Pima County Regional Wastewater Reclamation Department
Phone: 520-740-6609
www.pima.gov/wwm

City of Tucson Environmental Services:
Phone: 520-791-3171
www.tucsonaz.gov/esd

| Last Bill | Payments (Credits) | Deposits Applied | Adjustments | Balance Forward | New Charges | ACCOUNT BALANCE |
|---|---|---|---|---|---|---|
| $74.83 | -$74.83 | $0.00 | $0.00 | $0.00 | $65.33 | $65.33 |

**METER INFORMATION**

| Meter number | Service Type | Start Date | End Date | Current Read | Previous Read | Consumption (Ccfs) |
|---|---|---|---|---|---|---|
| | WA | 07/05/11 | 08/02/11 | 2141 | 2135 | 6 |




Your meter was read in Ccfs on 08/02/2011

**IMPORTANT MESSAGE**

On July 5, 2011 Water rate changes approved by Mayor & Council became effective. Questions? Please call 791-3242;outside Tucson,1-800-598-9449.
* On July 1, 2011 an increase in sewer rates became effective as approved by the Pima County Board of Supervisors. Questions on the sewer charge portion of your bill, call (520) 740-6609.
*Environmental Services charges reflect a fuel surcharge and an increase in the groundwater protection fee.

**ACCOUNT ACTIVITY**

| | |
|---|---|
| LAST BILL | $74.83 |
| TOTAL PAID SINCE LAST BILL | -$74.83 |
| ADJUSTMENTS | $0.00 |
| **BALANCE FORWARD** | **$0.00** |
| **NEW CHARGES** | |
| ENVIRONMENTAL SVCS FEES | $17.24 |
| SEWER VOLUME | $28.61 |
| WATER VOLUME | $17.85 |
| MISCELLANEOUS | $1.63 |
| **TOTAL NEW CHARGES** | **$65.33** |
| **ACCOUNT BALANCE** | |
| **DRAFT AMOUNT ON: 08/23/2011** | **$65.33** |

Due date applies to current charges ONLY.
Any balance forward is due now.
Please allow 7 days for payments to post to your account.

A $28.00 fee will be charged for any returned check.

BANK DRAFT - PLEASE DO NOT PAY

UTILITY SERVICES
PO Box 28804
Tucson, AZ 85726-8804

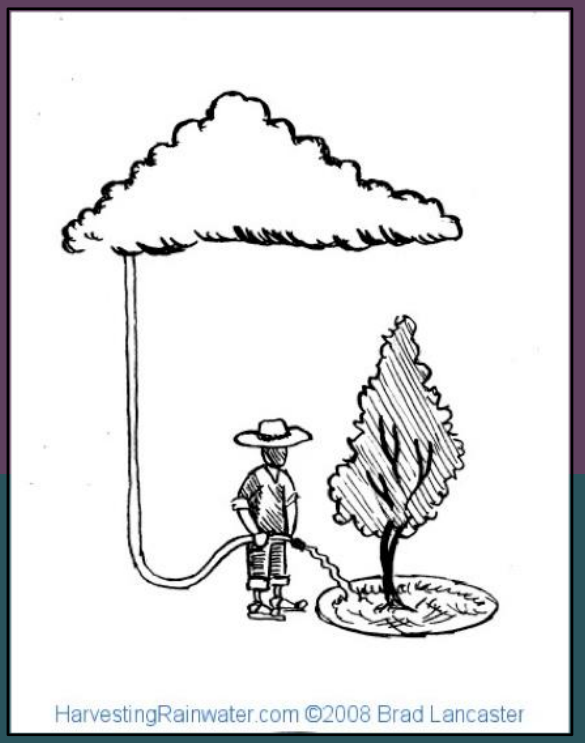
Please fold on perforation before tearing and return bottom portion with your payment.

Account Number:
Service Address:
Cycle-Route #: 04-52

| | |
|---|---|
| DRAFT DATE: | 08/23/2011 |
| DRAFT AMOUNT: | $65.33 |
| Open Space / Riparian Contribution (optional) | |
| AMOUNT PAID: | BANK DRAFT - DO NOT PAY |

Your tax-deductible contribution to "Open Space or Riparian Enhancement" will support the preservation of biologically-rich open space and the Conserve to Enhance program, an effort that links local river and wash enhancement with individual water conservation efforts. Visit www.tucsonaz.gov/water/checkbox to learn more. Your contribution will not affect service fees.

# *Results*




From 2011 - 2014:

- Over **6 million gallons** of water saved
- Over**$55,000** in community donations invested in 7 local river restoration projects

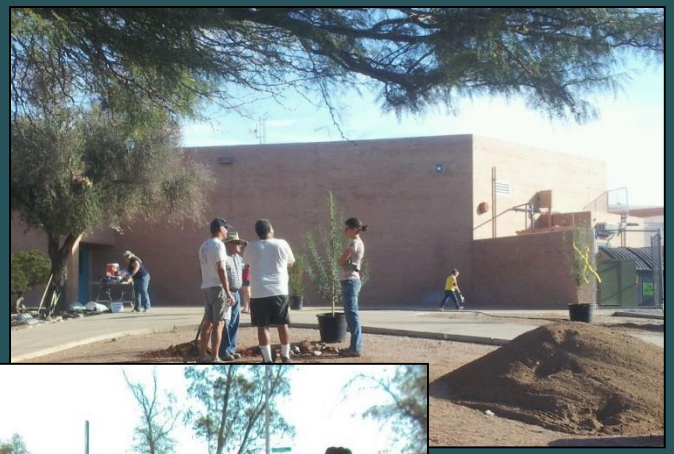
Atturbury Wash before (left) and after (right) Tucson C2E enhancement efforts.

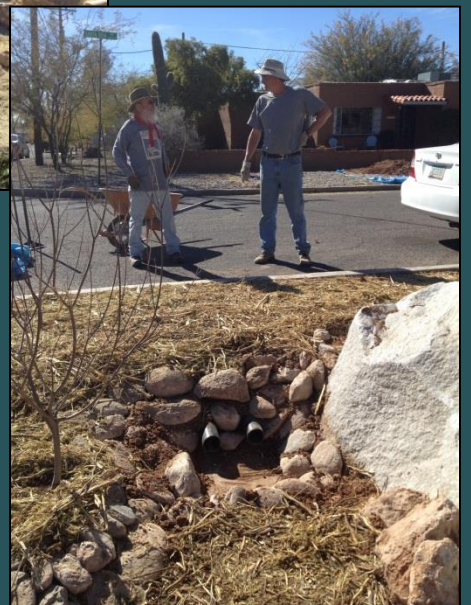
Photo Credit: Kendall Kroesen, Tucson Audubon Society

1. **Henry Elementary WINS!** – Wash Improvement and Neighborhood Sustainability submitted by Henry Elementary

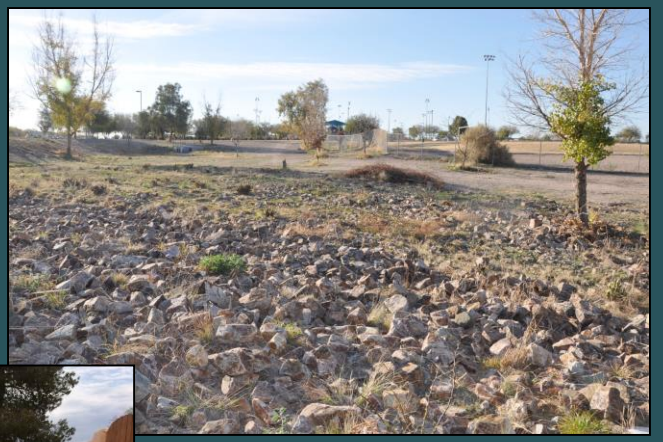
2. **1st Ave./Seneca Greening and Beautification** Project submitted by the Northwest and El Cortez Neighborhoods

3. **Mitchell Park Wildlife Habitat & Green Infrastructure Project** submitted by the Mountain/1st Ave





1. **Silverlake Park Urban Habitat Restoration** submitted Tucson Audubon Society

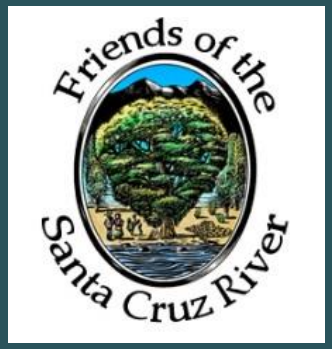


2. **Vine Ave. Green Corridor** Project submitted by the Jefferson Park Neighborhood Association

3. **Palo Verde Neighborhood B-54 Wellsite Beautification Project** submitted by the Palo Verde Neighborhood

# Acknowledgements












# Thank You!

# Living River Report
# Aquatic Indicators

| Indicators and Standards | Standard Source and Type |
|---|---|
| Dissolved Oxygen: > 1 mg/L | ADEQ: wildlife in effluent |
| Ammonia: varies w/ temp. and pH | ADEQ: wildlife in effluent |
| Total phosphorous: < 5 mg/L | Historic (1992-1999 median) |
| E. coli: < 235 CFU/100 mL | ADEQ: human health |
| Metals: varies by specific metal | ADEQ: wildlife |
| Aquatic Invertebrates: 2008 baseline | Baseline information |
| Fish: 2008 baseline | Baseline information |

# Living River Report
# Aquatic Indicators

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# Speaker Contacts

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Email: neal.shapiro@smgov.net

**Emily Brott**, Sonoran Institute

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**Eva Birk,** ORISE Fellow, U.S. EPA Office of Wastewater Management

Birk.eva@epa.gov, (202) 564-3164

**Emily Ashton,** ORISE Fellow, U.S. EPA Office of Wastewater Management

Ashton.emily@epa.gov, (202) 564-3324

# Next Webcast – May 5, 2015

## *Getting More Green from your Stormwater Infrastructure*

- **Chris Kloss,** National Green Infrastructure Coordinator, US EPA
- **Dan Christian**, Senior Water Resource Engineer and Project Manager, Tetra Tech

*Registration in late April*

*Information and registration will be posted at*
http://water.epa.gov/infrastructure/greeninfrastructure/gi_training.cfm