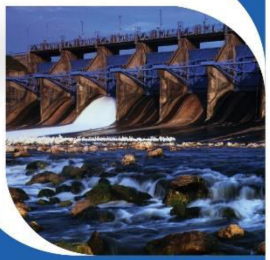
Village Creek-Lake Arlington Watershed Protection

Aaron Hoff

Trinity River Authority

September 22, 2016



Village Creek Lake Arlington WATERSHED PROTECTION

Trinity River Authority of Texas

Enriching the Trinity basin as a resource for Texans

Recap from Last Meeting

- Discussed Load Duration Curves and SELECT Analysis
  - Dr. Larry Hauck, Texas Institute for Applied Environmental Research (TIAER)
- Nominated and approved initial Steering Committee member list
  - Requested addition of a focus group for Education w/ 2 seats up for grabs
  - Faculty from TCC-D and UT-Arlington were nominated
  - Both were approved at 1st Committee meeting
- Discussed upcoming workshops
- Check the website for last meeting's presentations
  - http://www.trinityra.org/lakearlingtonvillagecreek

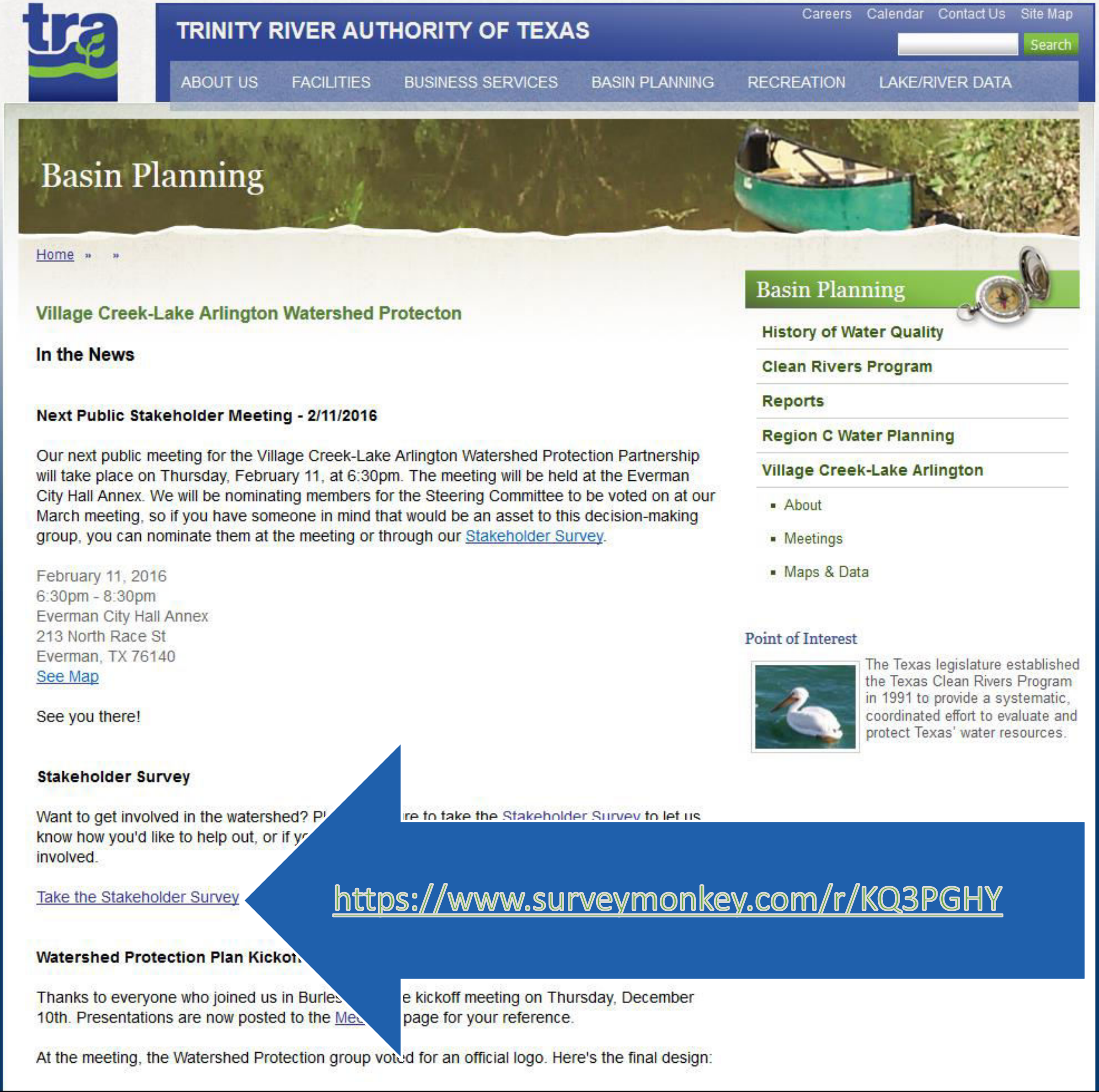
Accomplishments to Date

- Formation of Steering Committee
  - 17 members
  - Variety of focus groups (i.e., industry, municipalities, education, private landowners)
- Finalized the Monitoring Plan
  - Added additional stations
  - Expanded parameter sampling to all sites
- Learned about tools we'll be using to make decisions in the WPP
  - FDCs/LDCs
  - SELECT
- Stakeholder education workshops
  - Texas Watershed Stewards
  - Texas Riparian & Stream Ecosystems
  - Texas Well Owner Network

Meeting Overview

- Stormwater Green Infrastructure: Evaluation, Performance, and Modeling
  - *Fouad Jaber, Texas AgriLife Extension Service - Associate Professor & Extension Specialist*
- Rainwater Harvesting as Stormwater Mitigation
  - *Dotty Woodson, Texas AgriLife Extension Service - Extension Program Specialist*
- Water Quality Monitoring Update
  - *Angela Kilpatrick, Trinity River Authority – Senior Environmental Scientist*
- Upcoming Events and Path Forward
  - *Aaron Hoff, Trinity River Authority – Watershed Coordinator*
- Open Discussion and Closing Comments

http://www.trinityra.org/lakearlingtonvillagecreek



TRINITY RIVER AUTHORITY OF TEXAS

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Basin Planning

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Village Creek-Lake Arlington Watershed Protecton

In the News

Next Public Stakeholder Meeting - 2/11/2016

Our next public meeting for the Village Creek-Lake Arlington Watershed Protection Partnership will take place on Thursday, February 11, at 6:30pm. The meeting will be held at the Everman City Hall Annex. We will be nominating members for the Steering Committee to be voted on at our March meeting, so if you have someone in mind that would be an asset to this decision-making group, you can nominate them at the meeting or through our Stakeholder Survey.

February 11, 2016
6:30pm - 8:30pm
Everman City Hall Annex
213 North Race St
Everman, TX 76140
See Map

See you there!

Stakeholder Survey

Want to get involved in the watershed? Pl... re to take the Stakeholder Survey to let us know how you'd like to help out, or if y... involved.

Take the Stakeholder Survey

Watershed Protection Plan Kickof...

Thanks to everyone who joined us in Burles... e kickoff meeting on Thursday, December 10th. Presentations are now posted to the Me... page for your reference.

At the meeting, the Watershed Protection group vo... d for an official logo. Here's the final design:

Basin Planning

- History of Water Quality
- Clean Rivers Program
- Reports
- Region C Water Planning
- Village Creek-Lake Arlington
  - About
  - Meetings
  - Maps & Data

Point of Interest

The Texas legislature established the Texas Clean Rivers Program in 1991 to provide a systematic, coordinated effort to evaluate and protect Texas' water resources.

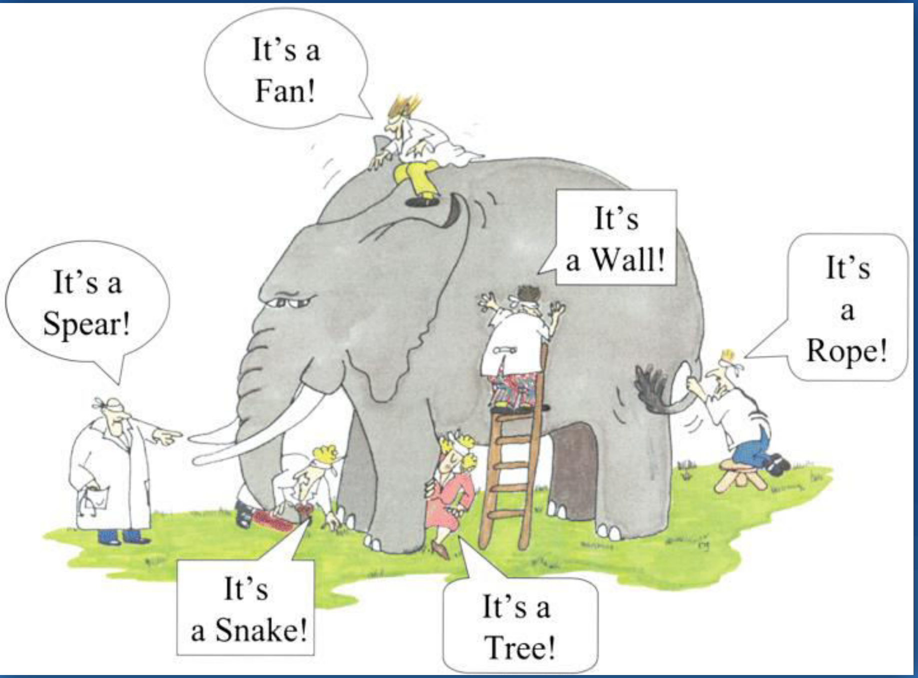
https://www.surveymonkey.com/r/KQ3PGHY

Funding Source

Funding provided by the Texas Commission on Environmental Quality through a Clean Water Act Section 319(h) grant from the U.S. Environmental Protection Agency, with match funding from the City of Arlington and in-kind contributions from TRA.

Ground Rules for Discussion Periods

- Please save questions until after each presentation has been given
- Any additional questions may be answered during the open discussion period at the end
- Please be respectful of others' time and points of view



Let’s get started!

http://www.trinityra.org/lakearlingtonvillagecreek

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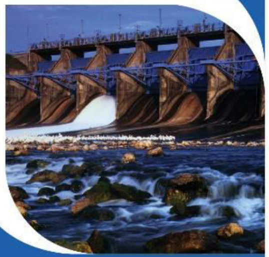

Stormwater Green Infrastructure: Evaluation, Performance and Modeling

Fouad H. Jaber, PhD, PE
Associate Professor and Extension Specialist
Biological and Agricultural Engineering
Texas A&M AgriLife Extension
Dallas Research and Extension Center

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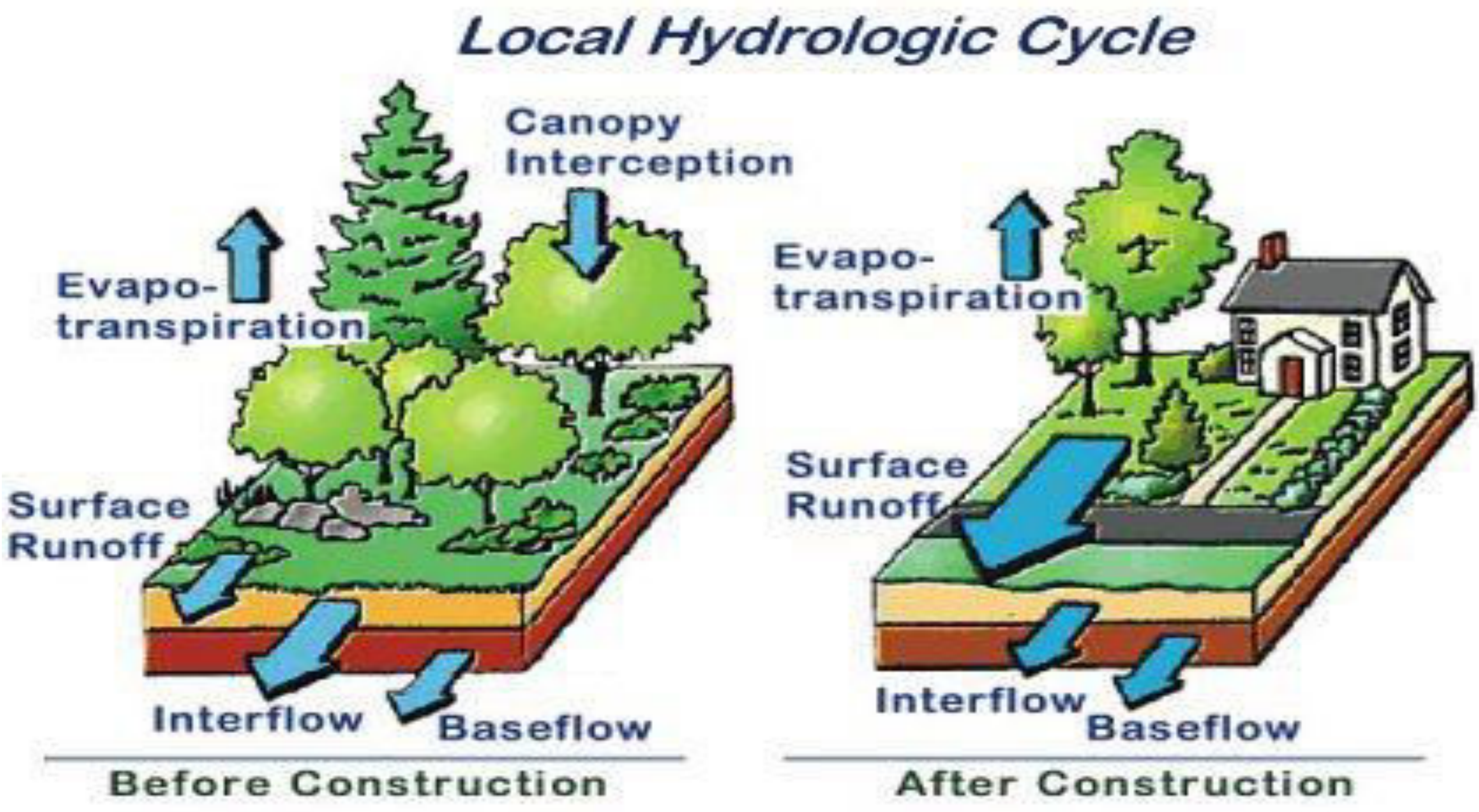
Urban vs. Natural



Why is Stormwater a Concern?

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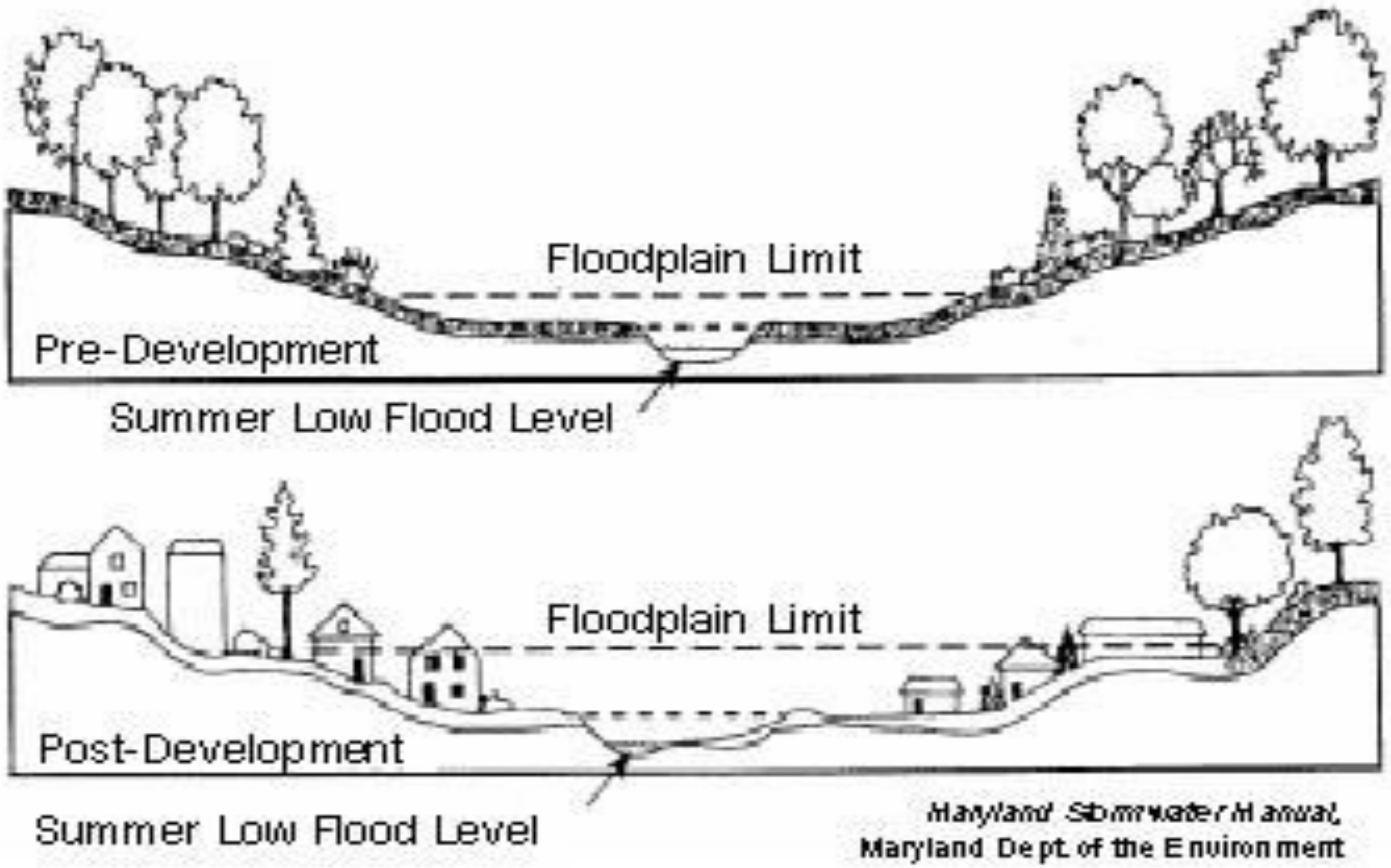


Why is Stormwater a Concern?

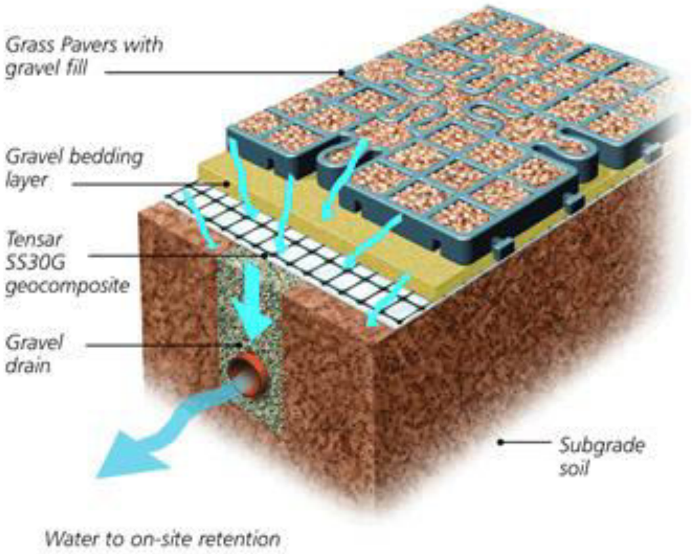
Eutrophication

- Impacts due to urbanization:
  - **Impact to aquatic habitat:** Degradation of habitat structure, loss of pool-riffle structure, reduction in base flow, increased stream temperature, and decline in abundance and biodiversity.

Fish kill at Lake Granbury.

Urban BMPs

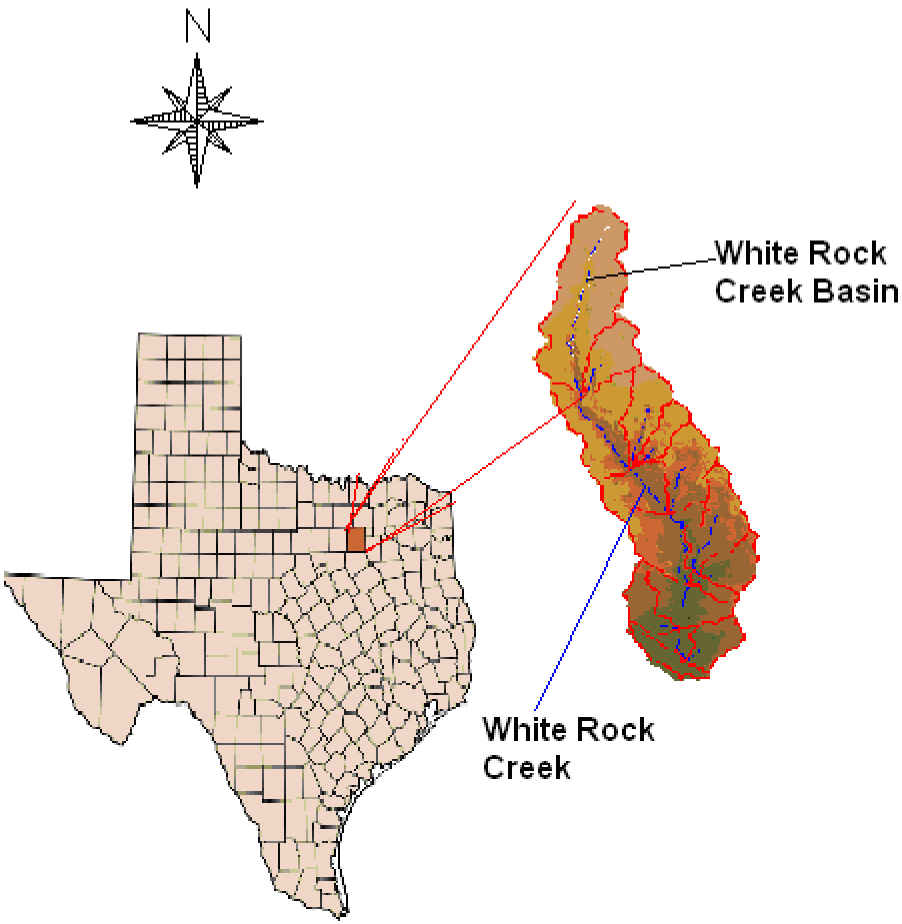
- Rain garden- bioretention areas
- Porous pavements
- Green roofs
- Rainwater harvesting



Evaluation Project in Dallas

- Five LID BMPs were built on the campus of Texas AgriLife Research and Extension, Dallas. The grant is funded by the Clean Water Act Section 319 urban nonpoint source pollution prevention program (TCEQ; EPA)
- BMPs
    - Permeable pavement
    - Bioretention area
    - Rainwater harvesting
    - Green roof
    - Detention Pond
- Monitoring for hydrology, N, P, TSS, bacteria, legacy pollutant Chlordane

Project Location

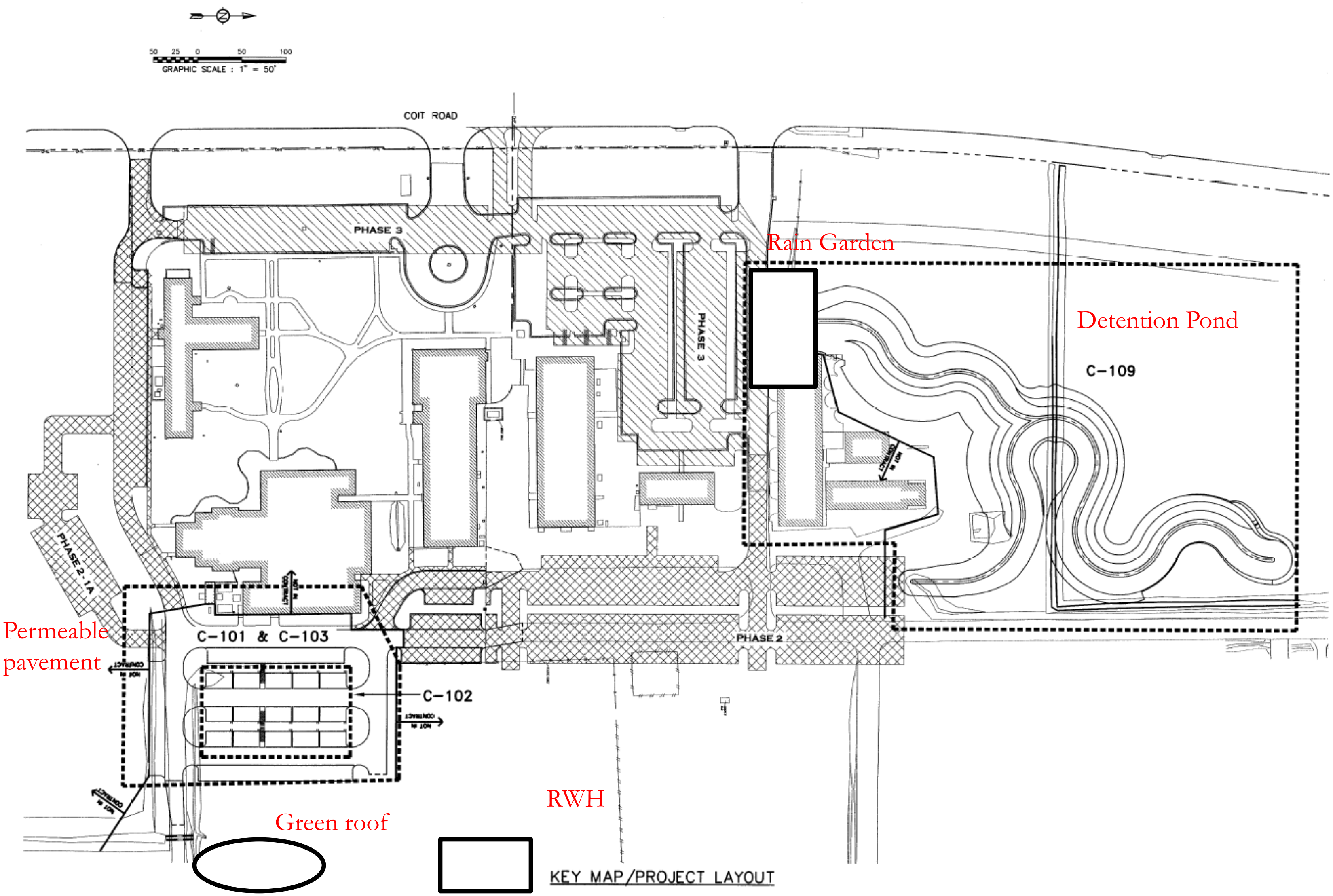


- Upper Trinity-White Rock Creek Watershed
- Clayey soil with underlying calcareous layer (Blackland Prairie Ecosystem)
- Representative of typical urban watershed

Rationale and Goals

- Need for evaluation of LID practices in the field, especially Southern US and/or Blackland soils.
- Need for data on adoption of LID practices on watershed scale
- Goals
  - Reduction of runoff volume, pollutant load in a typical urban development
  - Design, construction, evaluation of 5 LID BMPs
  - Teaching tool for integration of LID practices (de novo or retrofit)

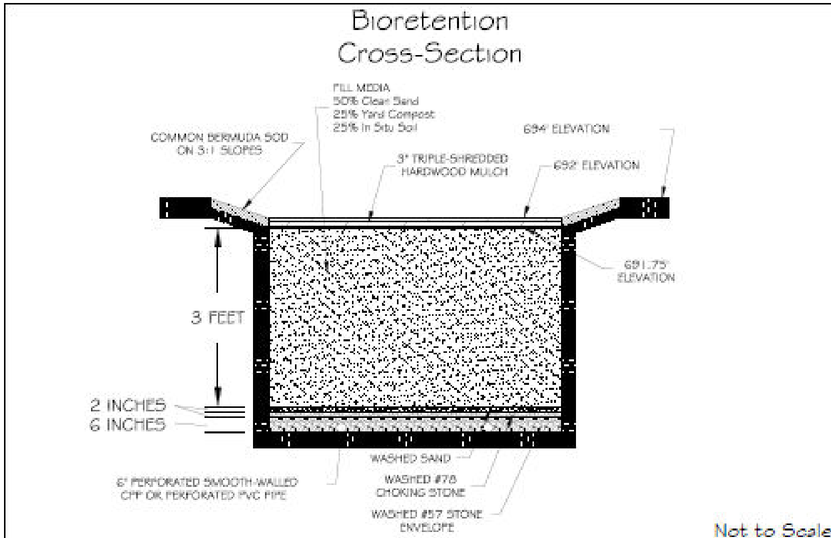
BMP Locations

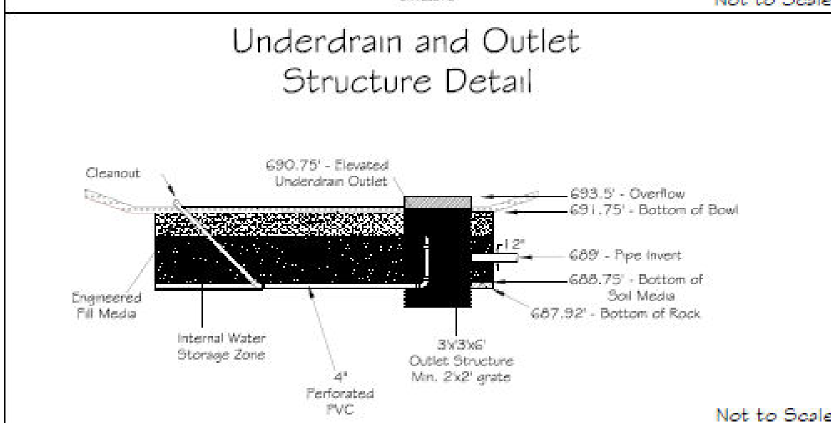


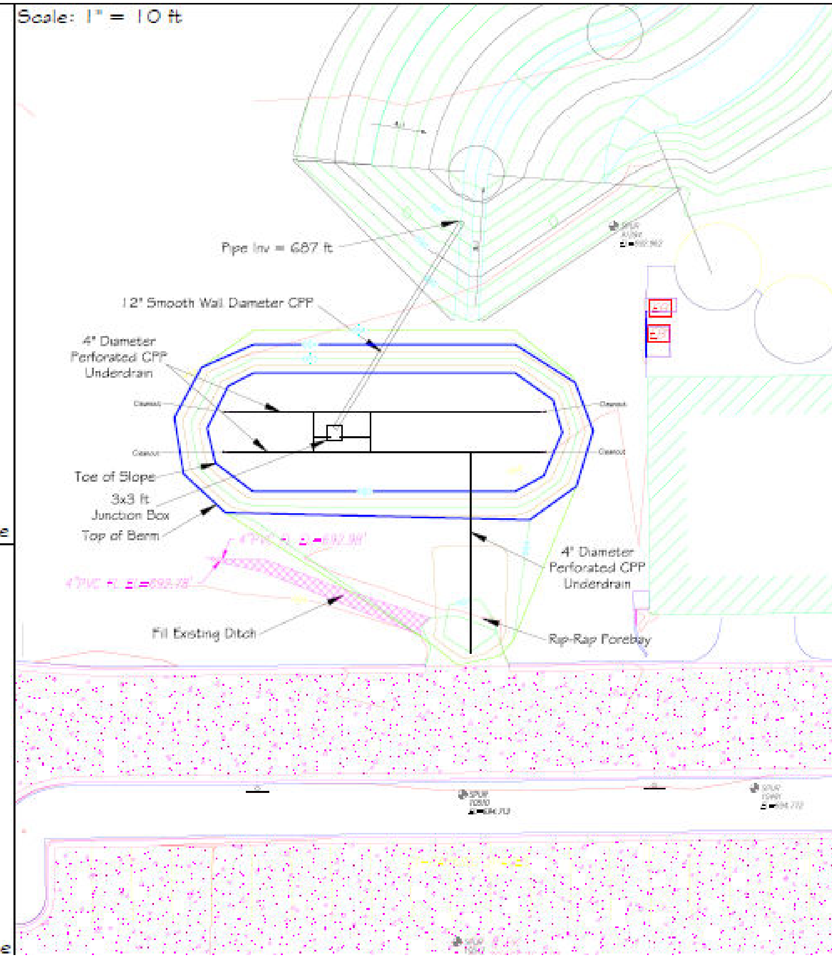
Bioretention Design

- Collected from 37,000 square foot parking lot CN=94
- Include Internal Water Storage (IWS)
- Total Media Depth was 4 feet with 1.75 feet ponding depth
- Media: 25% yard waste compost, 50% sand, 25% native soil
- Planted with native plants
- 4 inch perforated pipe at bottom

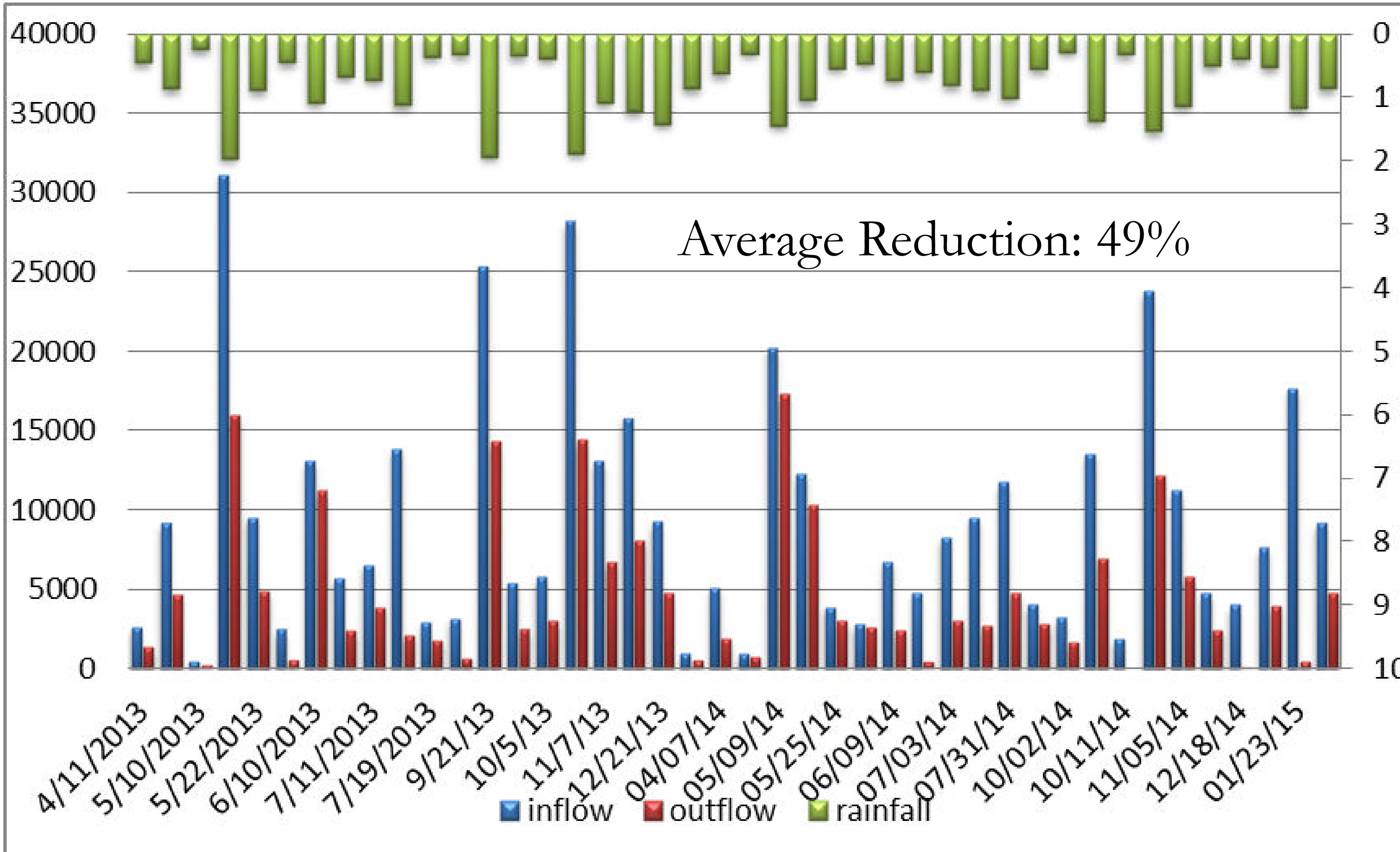
Bioretention Area



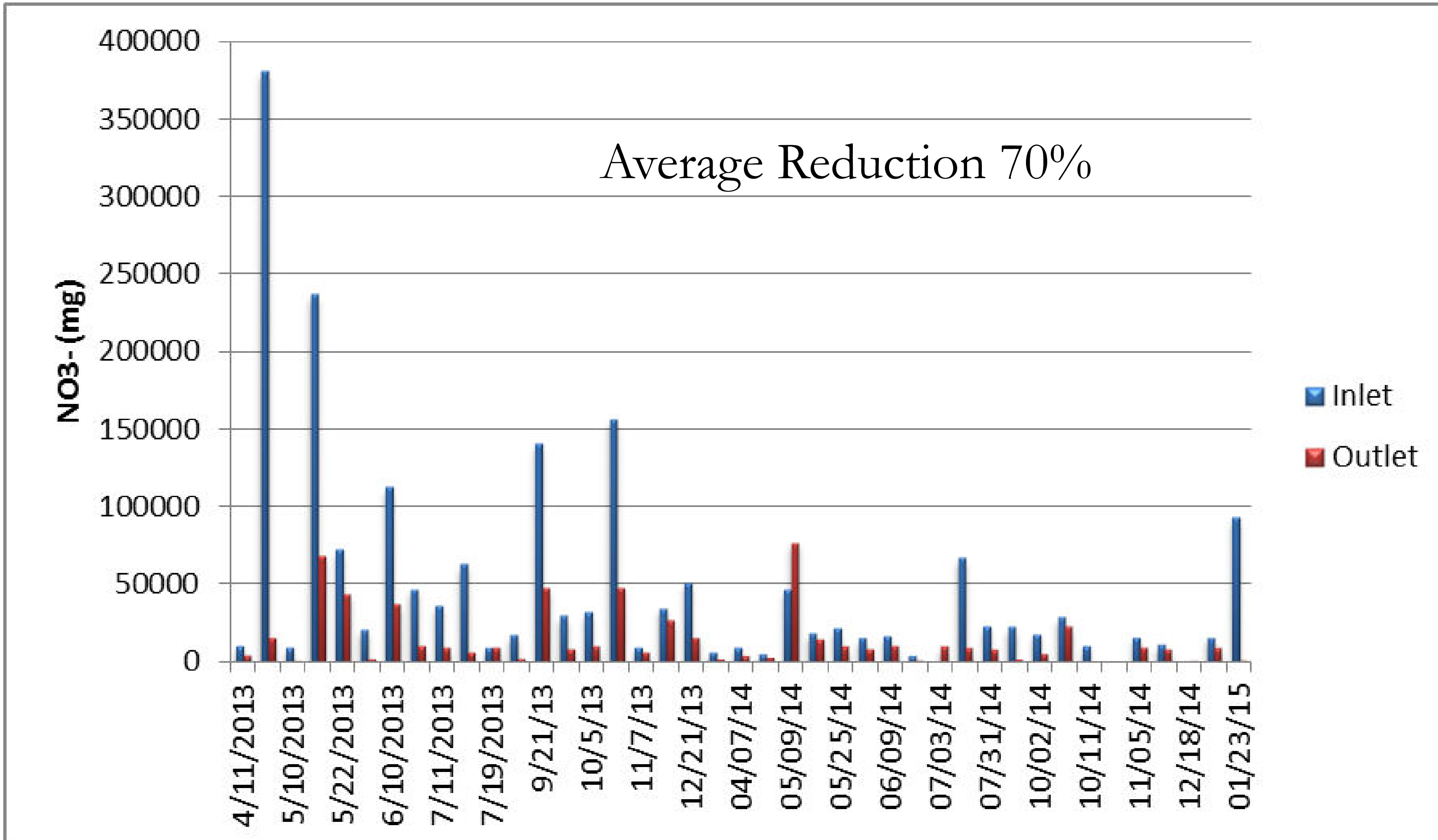




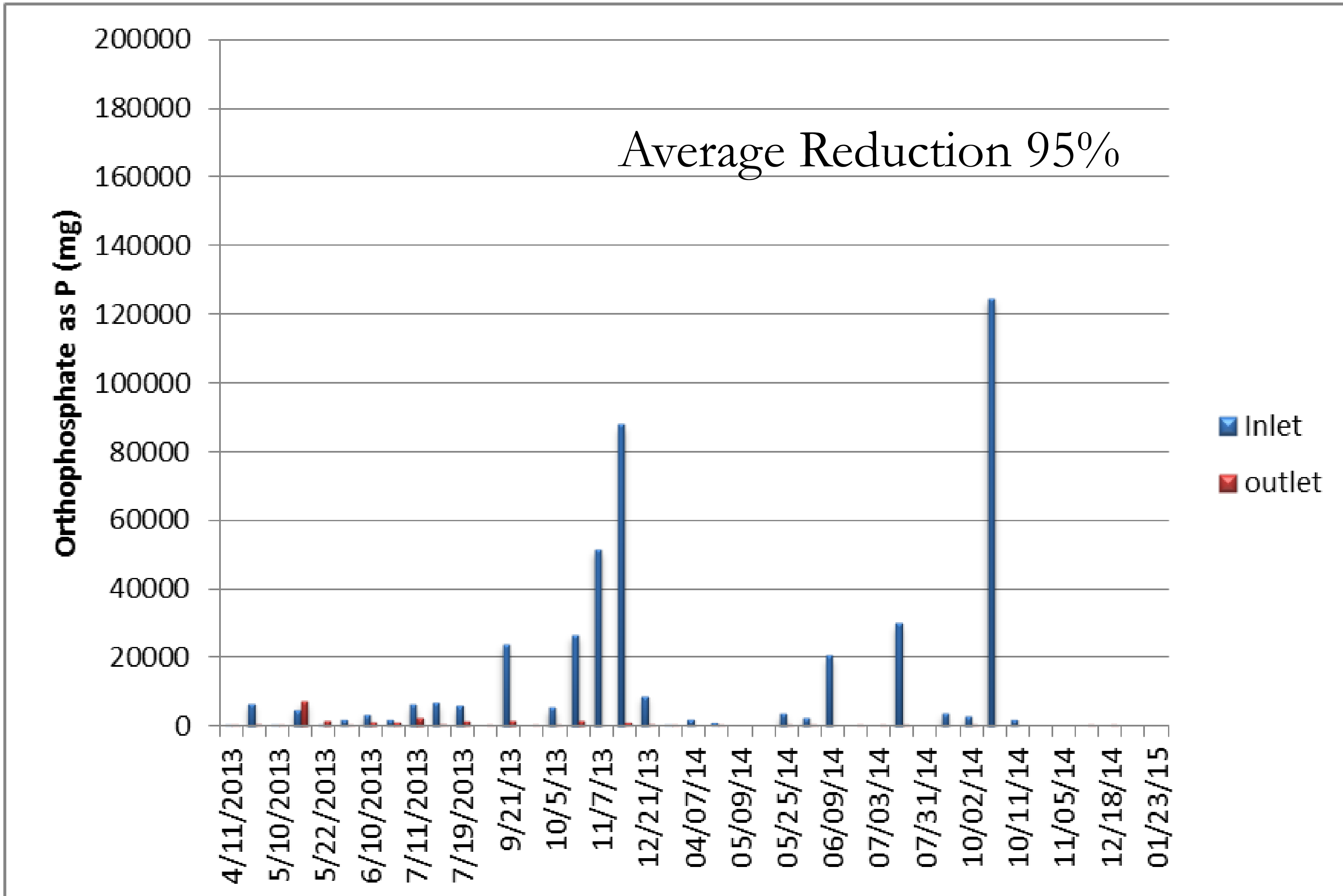
Volume Reduction



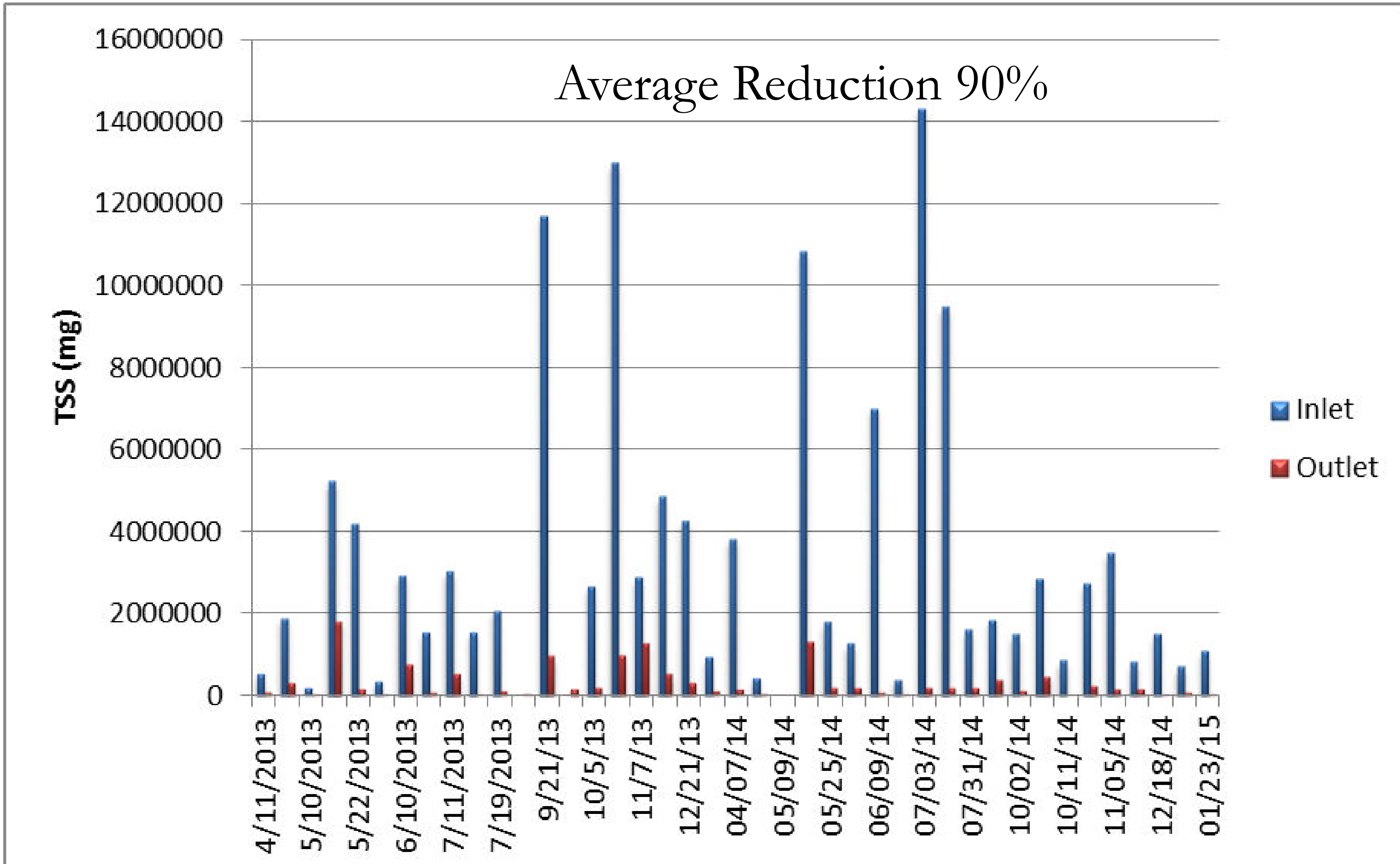
Load Reduction: Nitrate



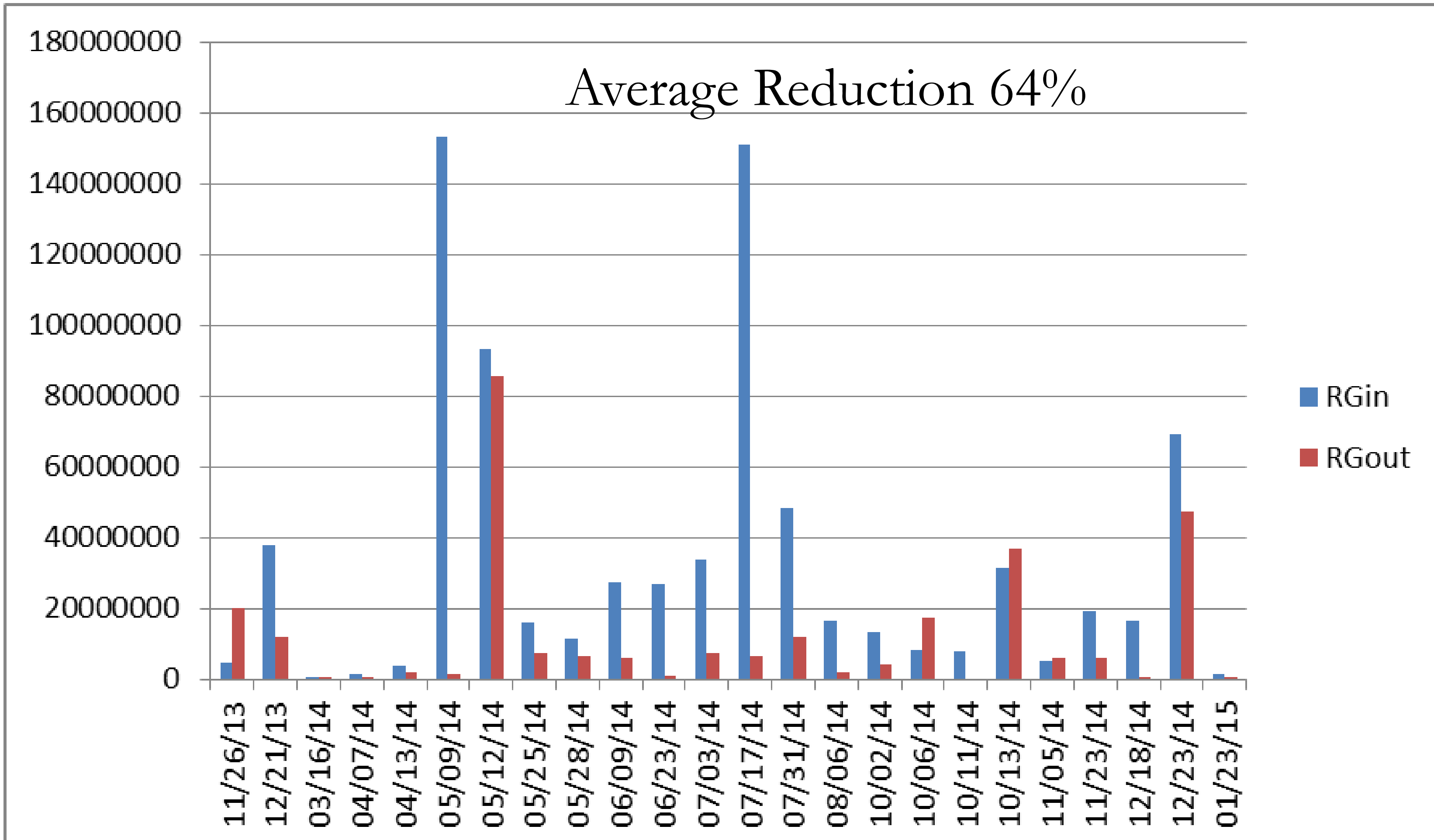
Load Reduction: Orthophosphate



Load Reduction: Sediments

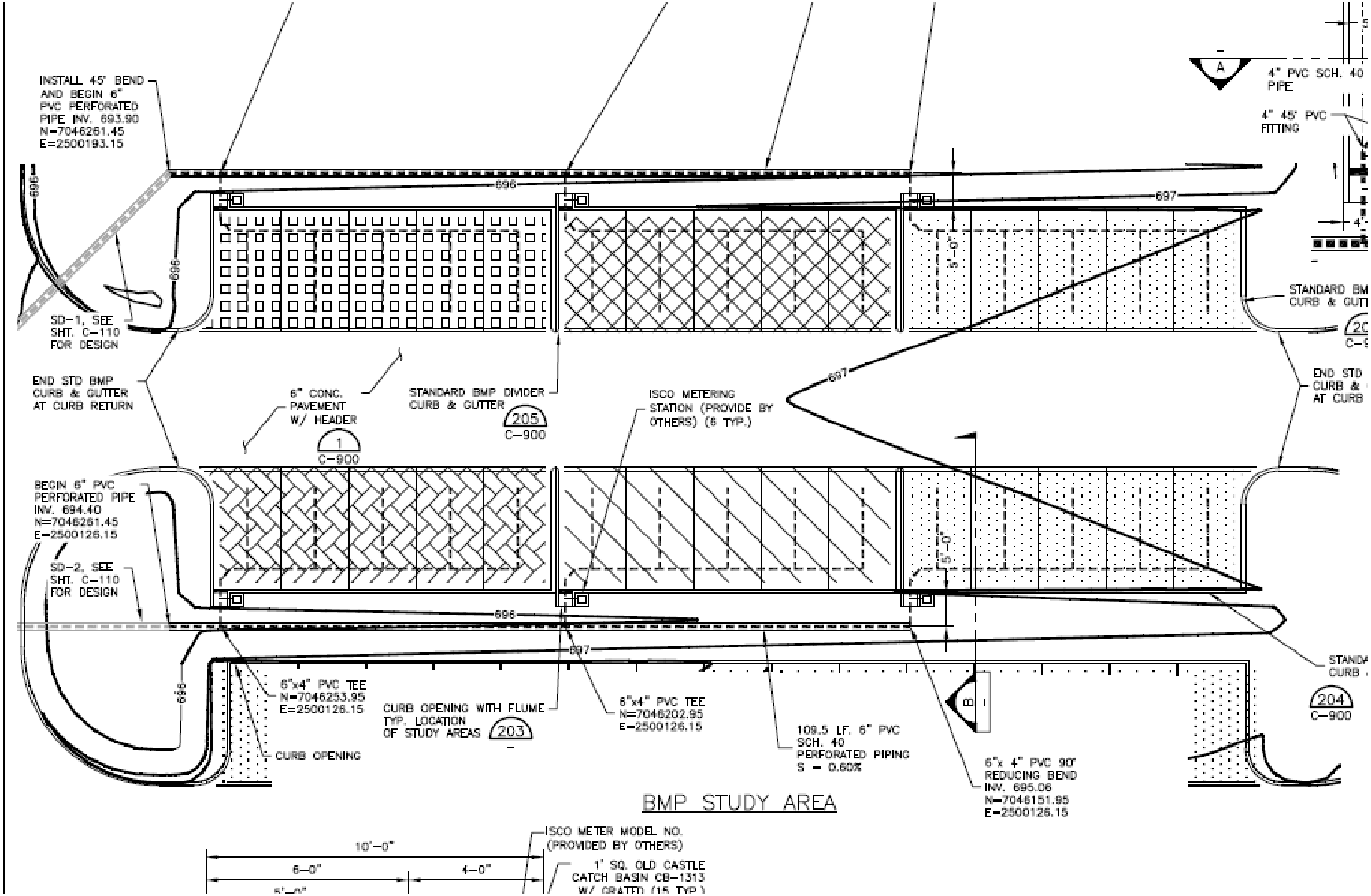


Load Reduction: E. coli



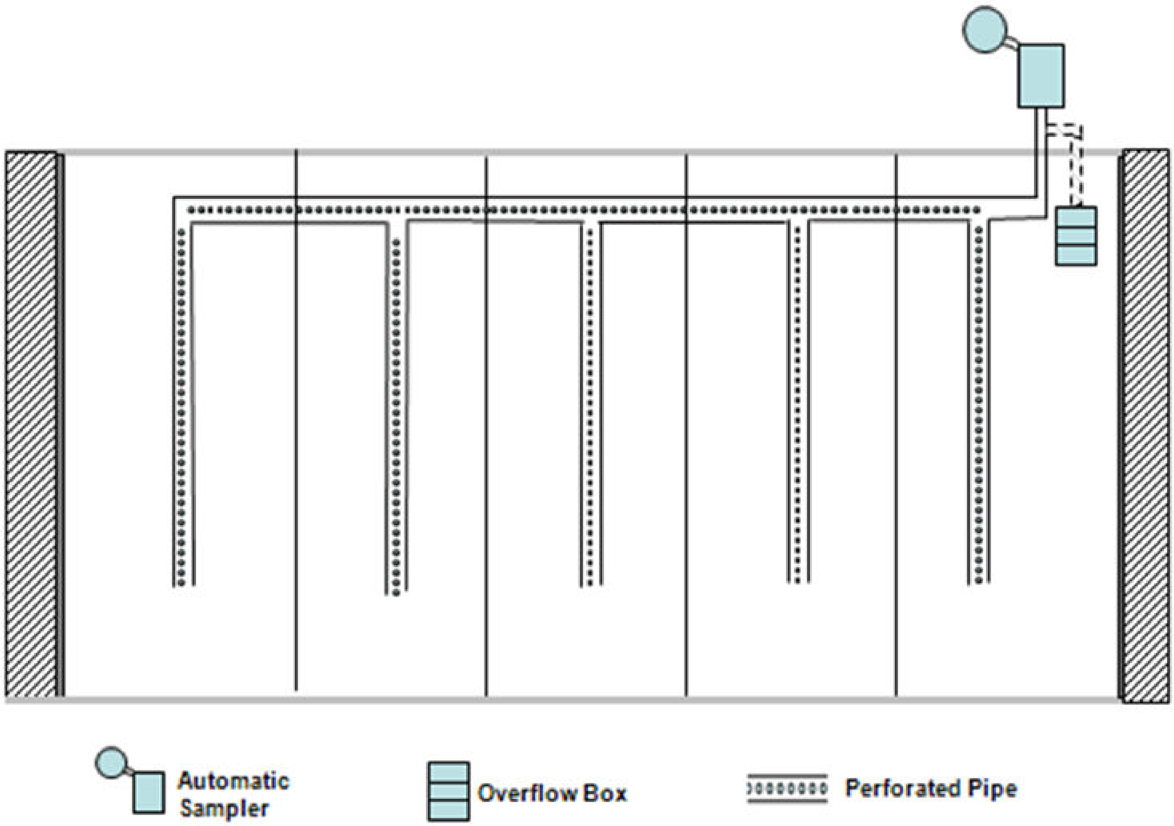
Permeable Pavement

- Newly constructed parking lot
- Comparison of 5 types pavement
- 25 experimental stalls among 52 total functional stalls
- Perforated underdrain pipes
- Total thickness = 16 inches
- Gravel layer
- Hydrologically separated with concrete curbs

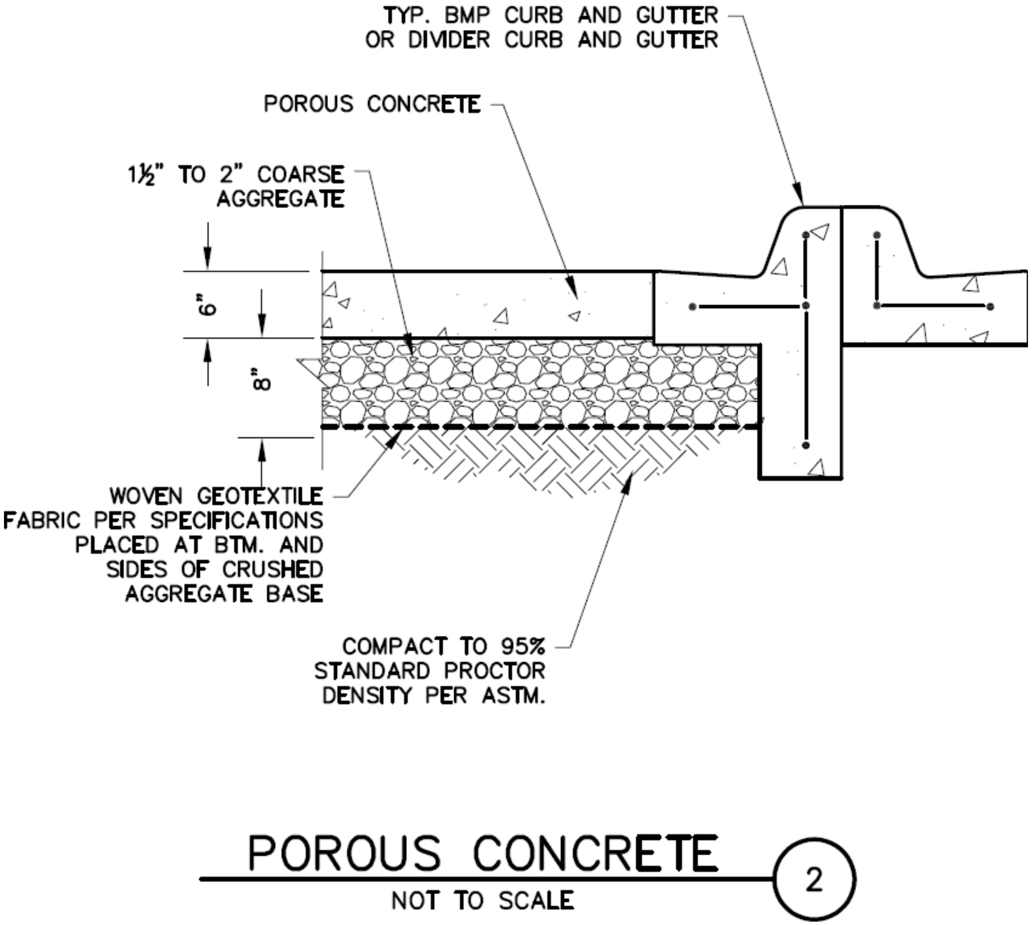

INSTALL 45° BEND AND BEGIN 6" PVC PERFORATED PIPE INV. 693.90 N=7046261.45 E=2500193.15
4" PVC SCH. 40 PIPE
4" 45° PVC FITTING
696
697
SD-1, SEE SHT. C-110 FOR DESIGN
END STD BMP CURB & GUTTER AT CURB RETURN
6" CONC. PAVEMENT W/ HEADER
1
C-900
STANDARD BMP DIVIDER CURB & GUTTER
205
C-900
ISCO METERING STATION (PROVIDE BY OTHERS) (6 TYP.)
5'-0"
BEGIN 6" PVC PERFORATED PIPE INV. 694.40 N=7046261.45 E=2500126.15
SD-2, SEE SHT. C-110 FOR DESIGN
698
6"x4" PVC TEE N=7046253.95 E=2500126.15
CURB OPENING
CURB OPENING WITH FLUME TYP. LOCATION OF STUDY AREAS
203
6"x4" PVC TEE N=7046202.95 E=2500126.15
109.5 LF. 6" PVC SCH. 40 PERFORATED PIPING S = 0.60%
6"x 4" PVC 90° REDUCING BEND INV. 695.06 N=7046151.95 E=2500126.15
204
C-900
A
B
BMP STUDY AREA
ISCO METER MODEL NO. (PROVIDED BY OTHERS)
10'-0"
6'-0"
4'-0"
1' SQ. OLD CASTLE CATCH BASIN CB-1313

Design and Monitoring

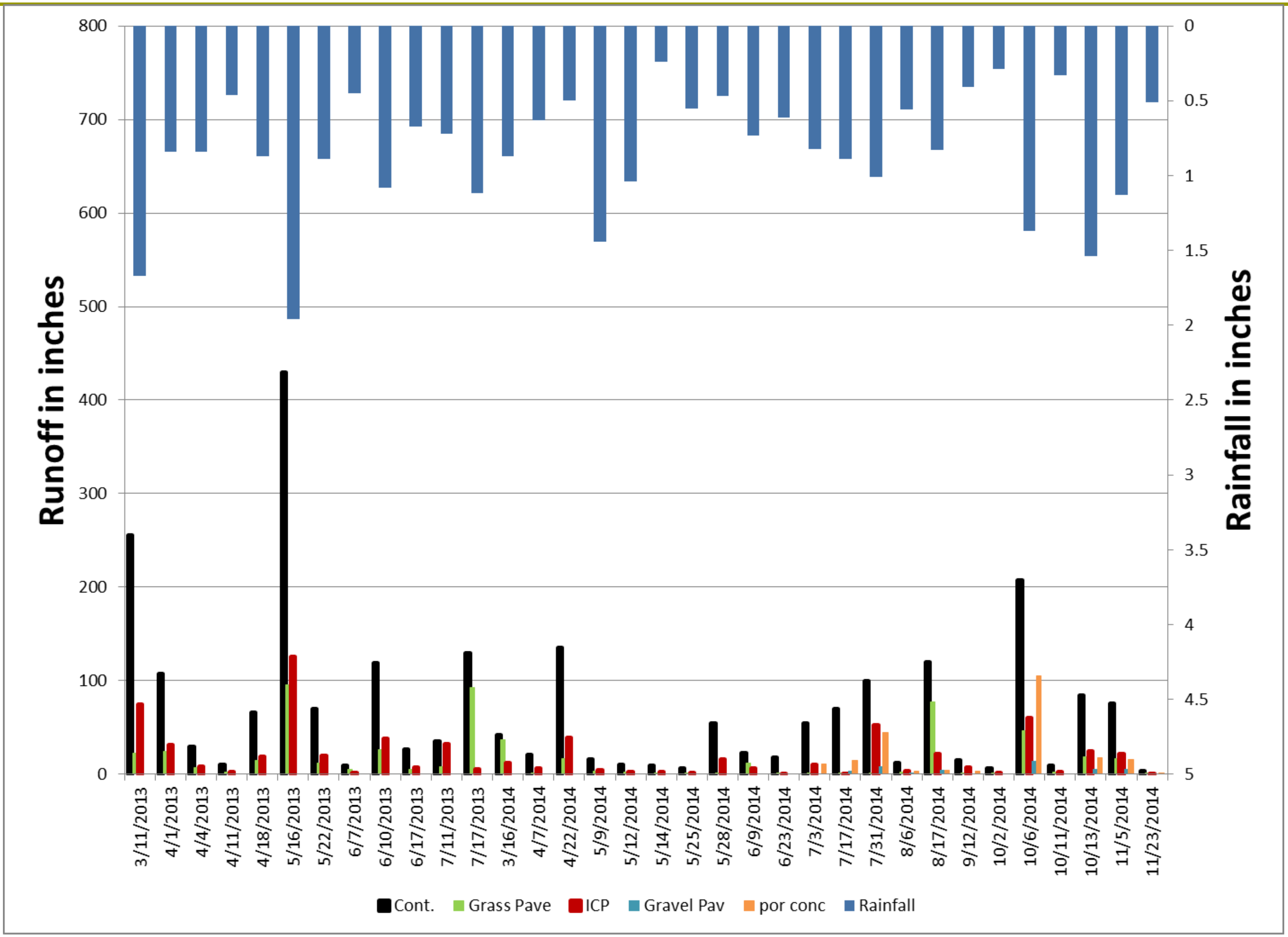
- Stalls: 18’x10’
- ISCO samplers with bubbler flow meters
- Runoff quantity and quality is measured



Pervious Concrete Cross Section



Results: Volume



Volume Reduction Rates

	PICP	Pervious Concrete	Grass Pavers	Gravel Pavers
Reduction Rate	**71%**	**74%**	**78%**	**93%**

Results: Water Quality

	Control (mg)	Grass Pave (mg)	Grass Pave % reduction	ICP (mg)	% reduction
NO3	221.98	857.55	**-286%**	654.27	**-195%**
NH4	272.07	173.43	**36%**	60.64	**78%**
TKN	2327.54	1760.51	**24%**	1023.3	**56%**
Orthophosphate	2.46	12.08	**-391%**	20.84	**-747%**
Total Phosphorus	53.66	85.37	**-59%**	107.87	**-101%**
TSS	59833.46	9648.71	**84%**	32306	**48%**

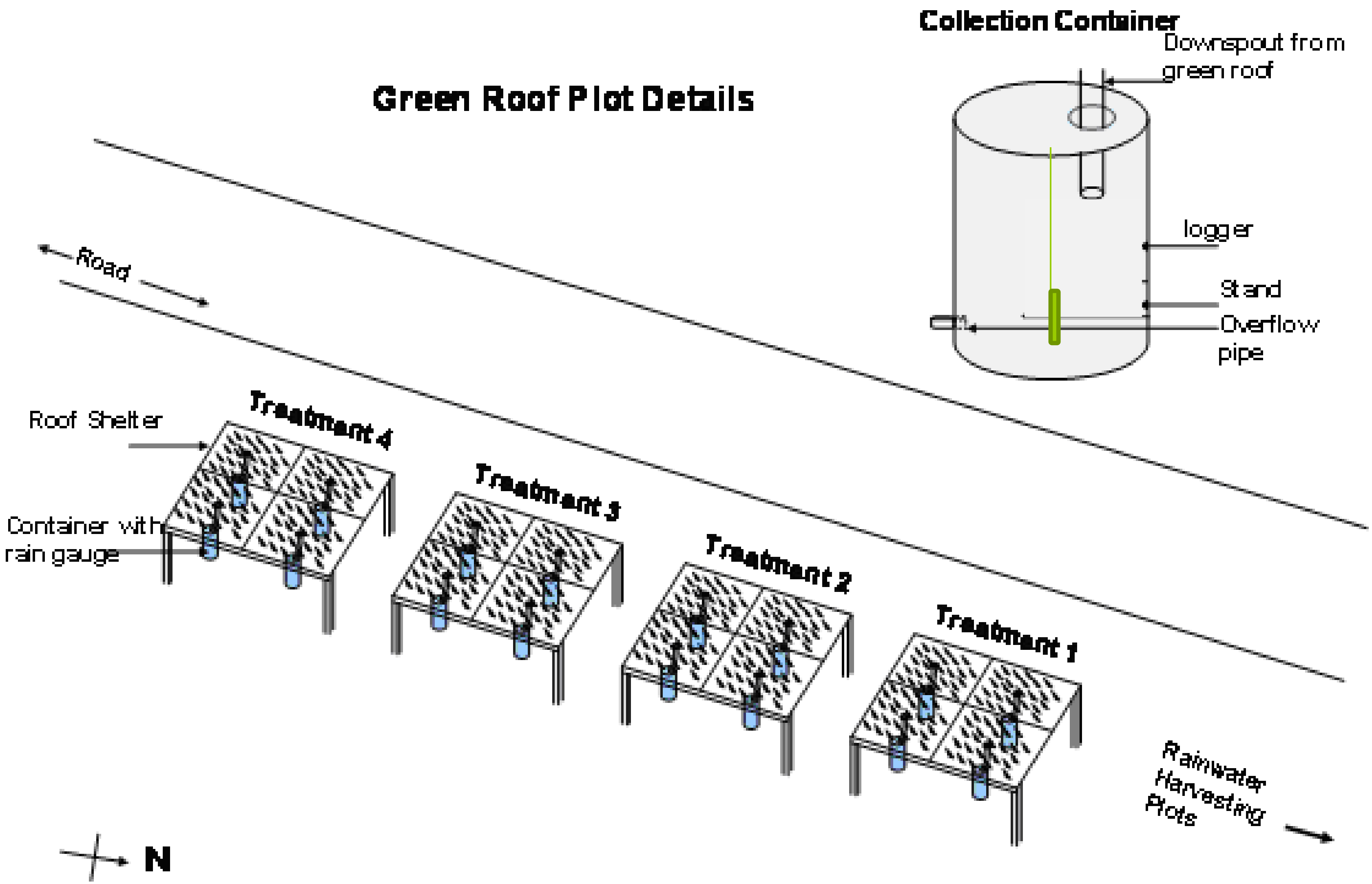
TSS Reduction in Per Conc: 57%

in Gravel pavers: 48%

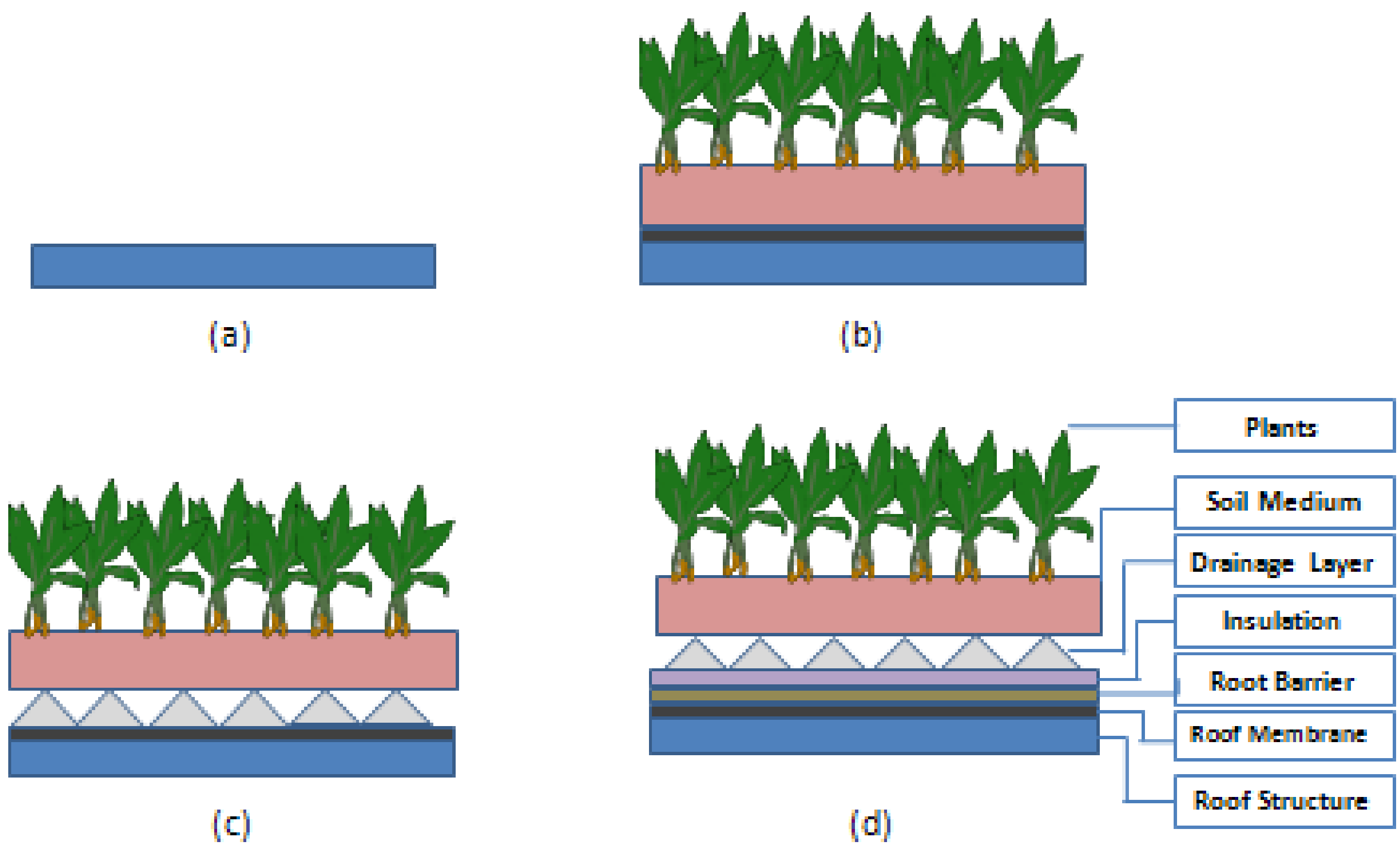
Green Roofs in North Texas

- Experimental Component
  - 4 roof shelters, represent residential roofs
  - Each divided into 4 parts, with 4 types of growing media
  - Different layers of soil, drainage, insulation, roofing membrane
  - Runoff volume, water quality

Green Roof Plot Details



Growth Medium



Volume Reduction

Event	Rainfall	C	H	H reduction	S	S reduction	SD	SD Reduction
Date	inches	gals	gals	%	gals	%	gals	%
05/09/14								
05/12/14								
06/09/14								
07/03/14	0.82	5	3.4	0.32	0.17	0.97	0.17	0.97
07/17/14	0.89	6.7	1.47	0.78	0.1	0.99	2	0.70
07/31/14	1.01	7.7	6.1	0.21	0.24	0.97	1.18	0.85
08/06/14	0.56	2.7	0	1.00	0	1.00	0.29	0.89
08/17/14	0.83	4.7	1.18	0.75	0	1.00	0.29	0.94
10/06/14	1.37	15.8	5.54	0.65	2.47	0.84	4.1	0.74
10/13/14	1.54	22	11.9	0.46	8.7	0.60	9.3	0.58
10/13/14	1.54	22	11.9	0.46	8.7	0.60	9.3	0.58
11/05/14	1.13	9.02	0.17	0.98	0.35	0.96	0.29	0.97
11/23/14	0.51	2.5	0	1.00	0	1.00	0	1.00
12/23/14	0.53	3.89	0.59	0.85	0.35	0.91	0	1.00
01/12/15	0.63	4.5	0.66	0.85	2.4	0.47	0.94	0.79
01/23/15	1.17	7.58	3.56	0.53	3.63	0.52	3.28	0.57
02/02/15	0.72	35.7	25	0.30	1.12	0.97	0	1.00
02/25/15	2.22	15.58	8.63	0.45	1.36	0.91	5.66	0.64
03/06/15	1.1	2.36	0	1.00	1.35	0.43	0.17	0.93

Total Volume Reduction from C	**65.39%**	**76.05%**	**75.33 %**

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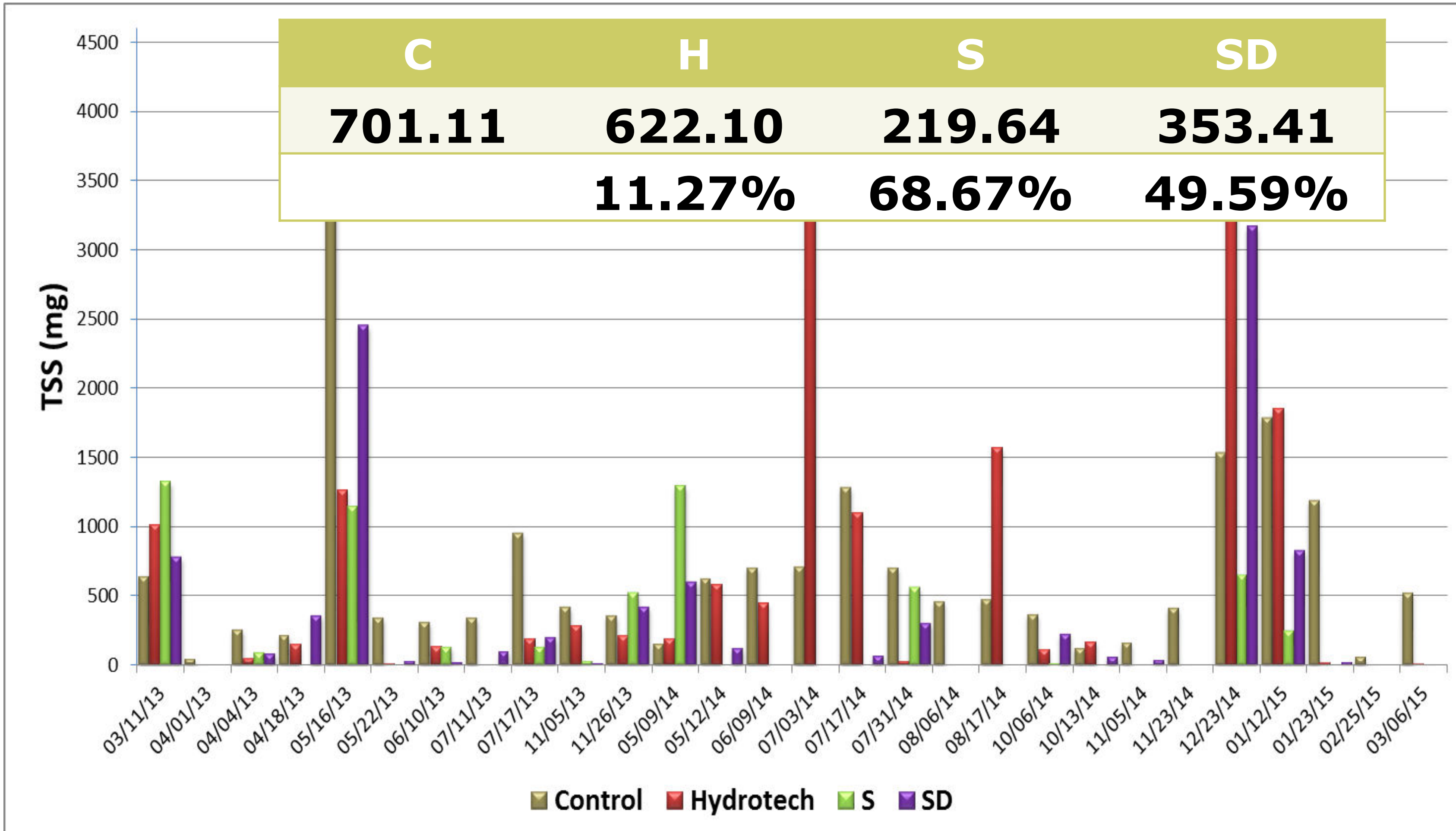
TSS Loads

C	H	S	SD
701.11	622.10	219.64	353.41
	11.27%	68.67%	49.59%



Rainwater Harvesting

- Demonstration Component
  - Four cisterns (300, 500, 1500, and 2500 gallon) that serve AgriLife Buildings
  - Storage and outflow measured
  - Serves a drip irrigation system
- Experimental Component
  - 4 roof shelters, represent residential roofs, 55 gallon tanks(3/plot)
  - Turf lawn associated with each, drip irrigation
  - 4 Treatments- Soil moisture, Evapotranspiration, Home owner (rain water), Control: Home owner (city water)
  - Inflow, outflow, water quality

Experimental plot layout

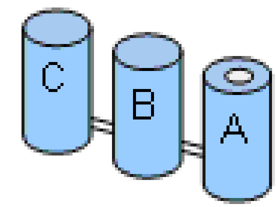
Rain water Harvesting Treatments

Plot 1 – Soil Moisture

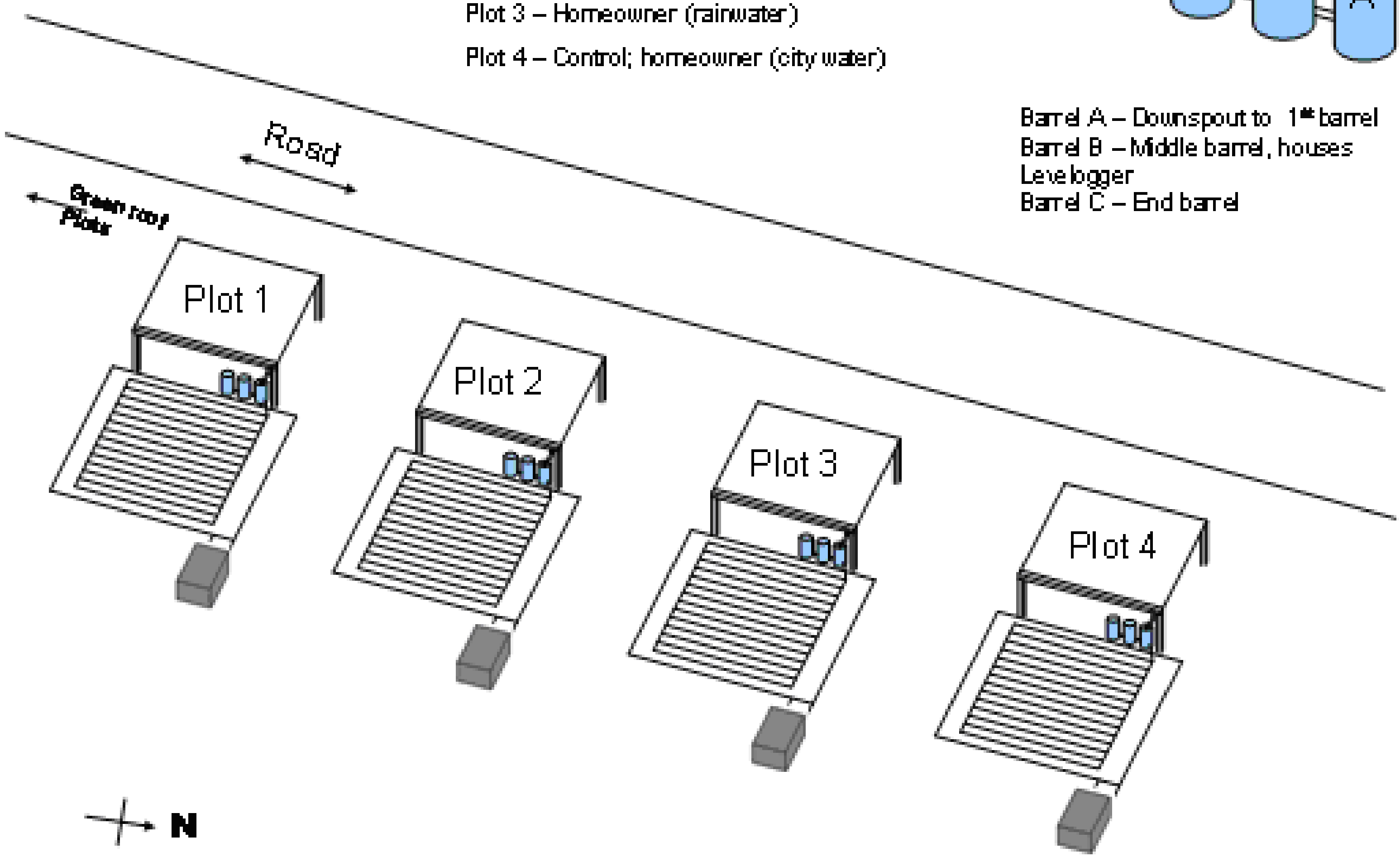
Plot 2 – Evapotranspiration

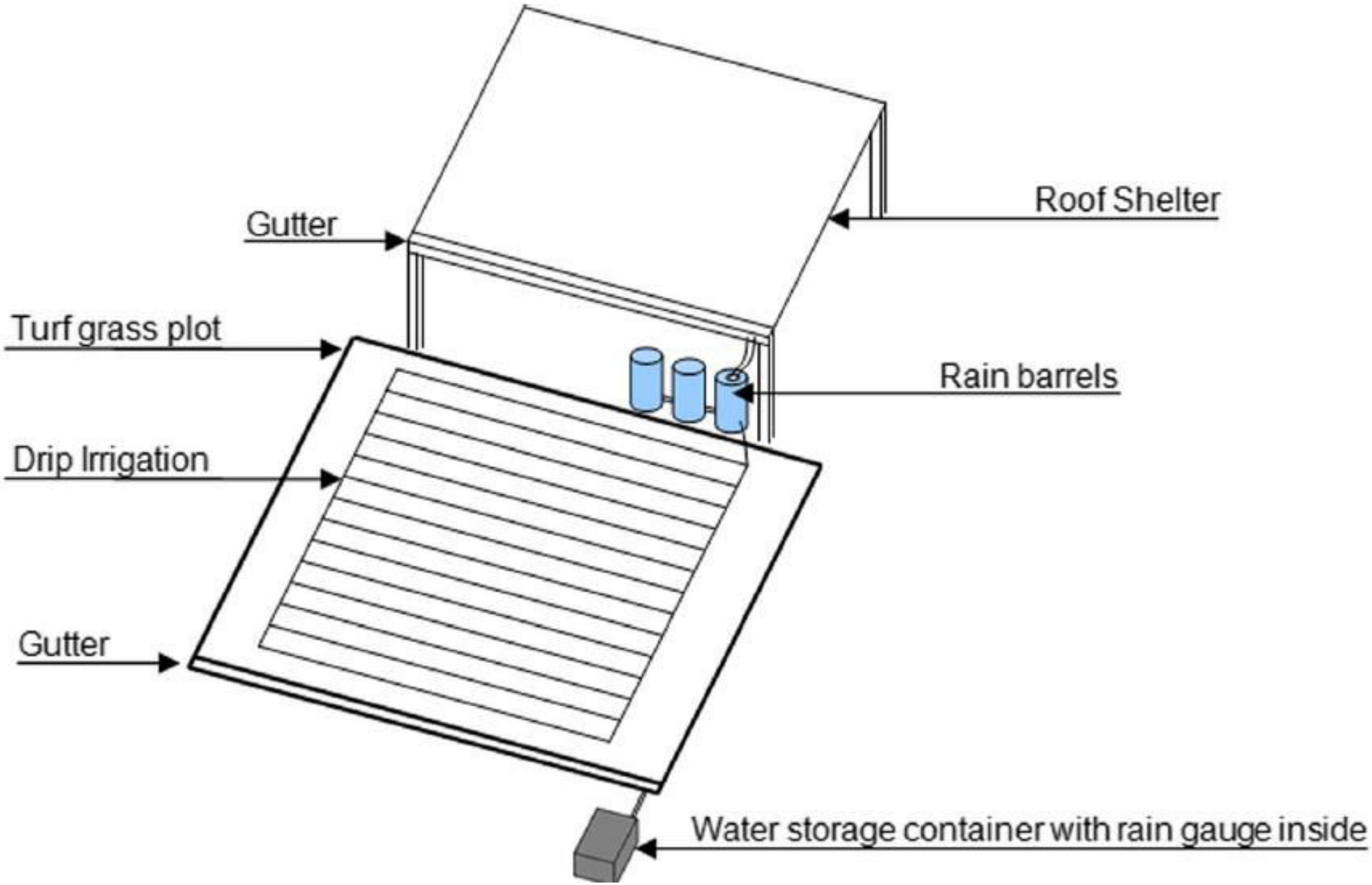
Plot 3 – Homeowner (rainwater)

Plot 4 – Control; homeowner (city water)

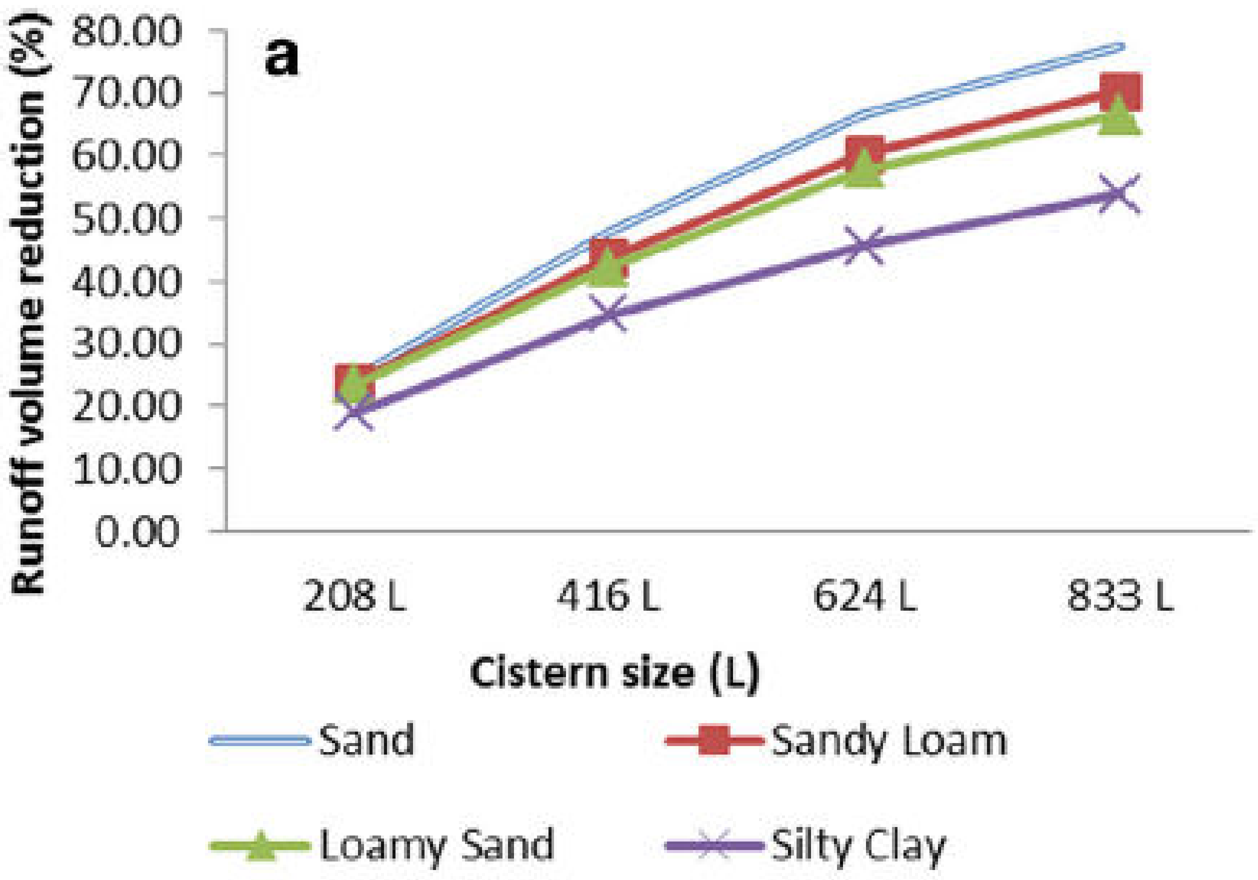


Barrel A – Downspout to 1st barrel
Barrel B – Middle barrel, houses Level logger
Barrel C – End barrel

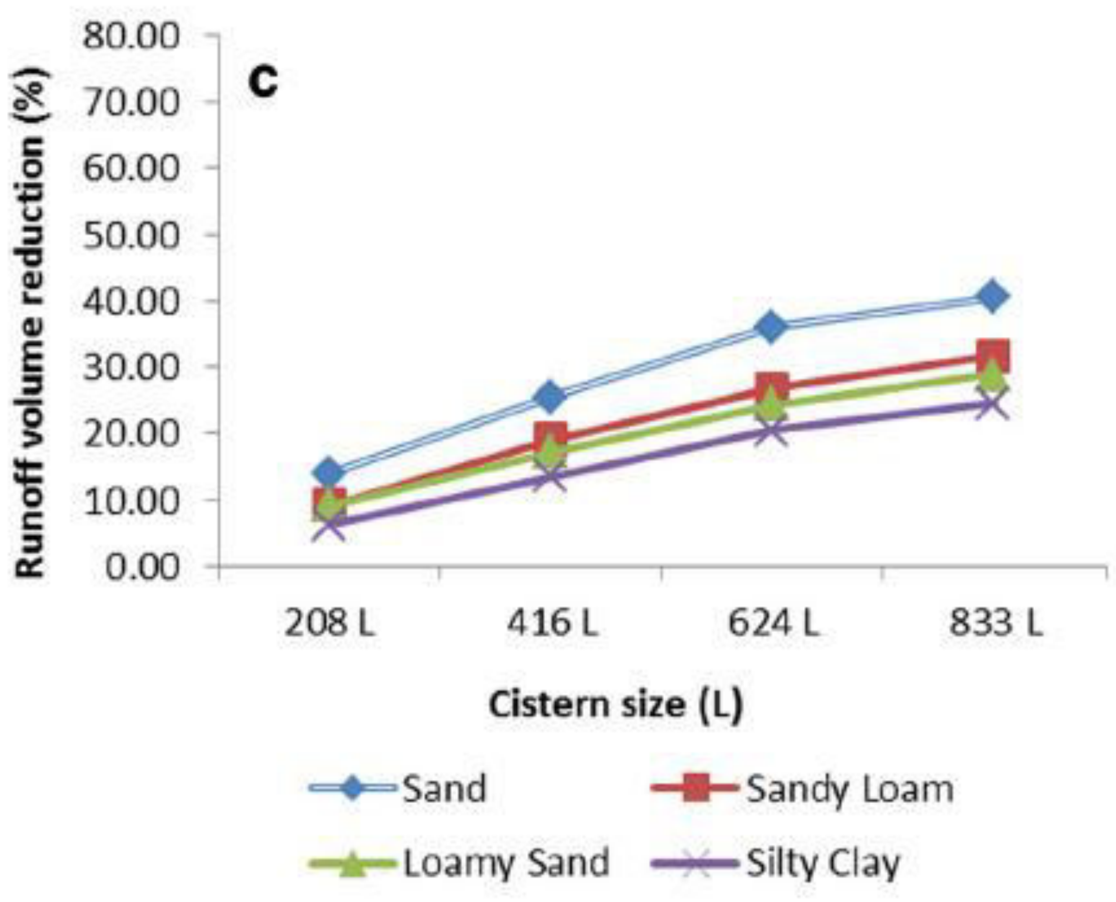



Roof Shelter
Gutter
Turf grass plot
Rain barrels
Drip Irrigation
Gutter
Water storage container with rain gauge inside

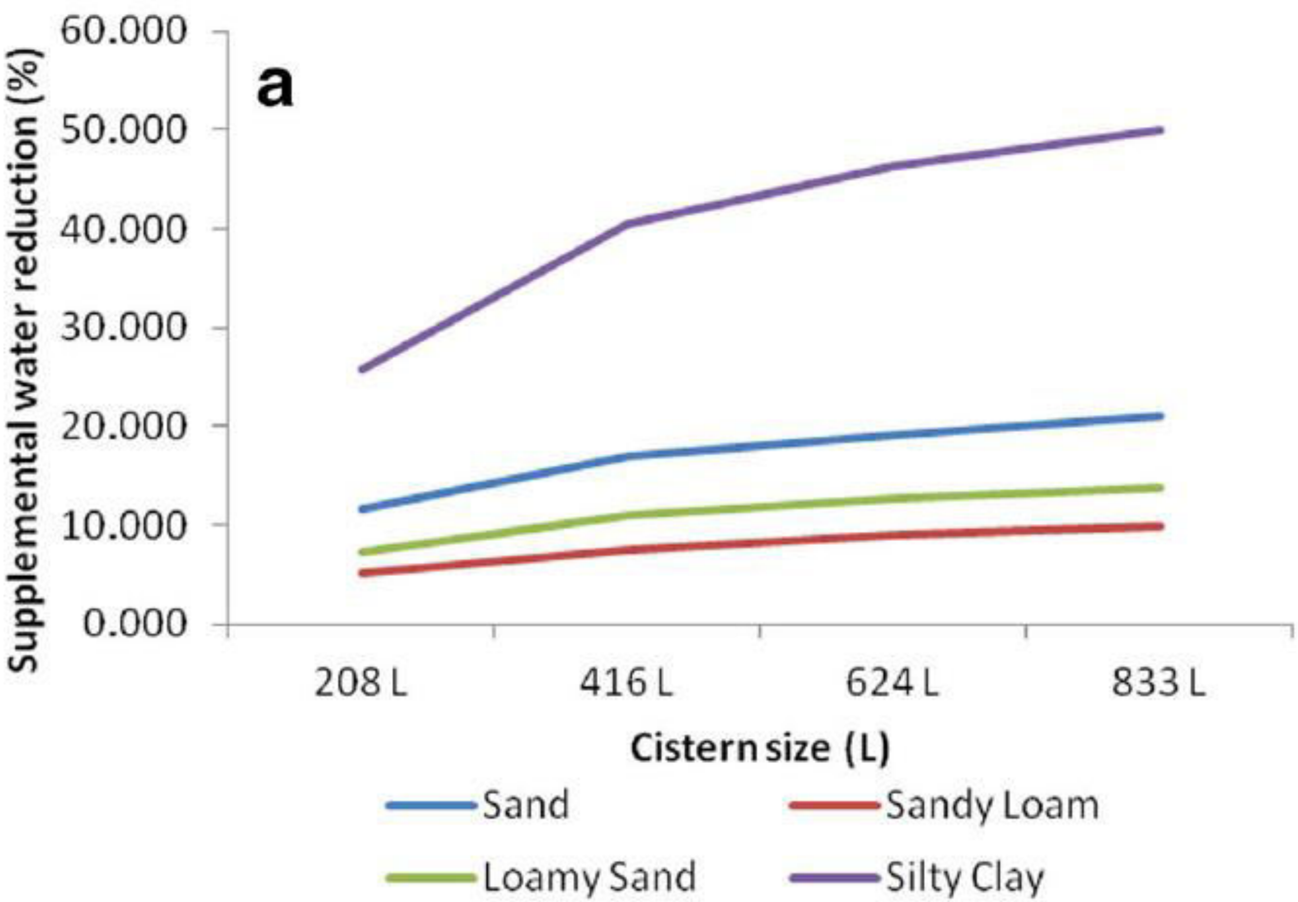
Runoff from time based



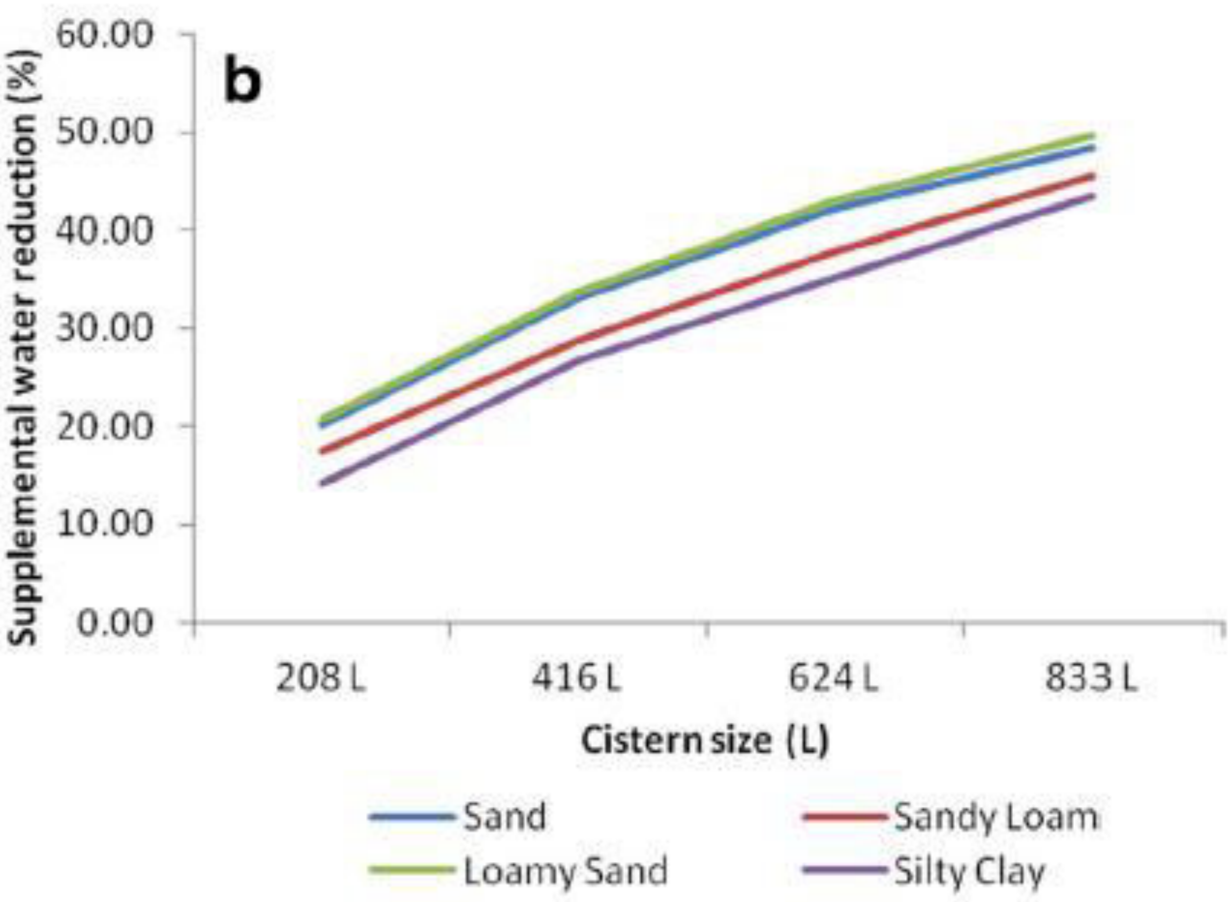
Runoff from ET-based



Water Savings from RWH



Water Savings Soil Moisture



BIOLOGICAL & AGRICULTURAL ENGINEERING
TEXAS A&M UNIVERSITY

Modeling LID Effect Practices on Stream Health

Fouad H. Jaber, PhD
Associate Professor and Extension Specialist
Sa'd Shannak, PhD
Former Graduate Student Currently at KAPSARC

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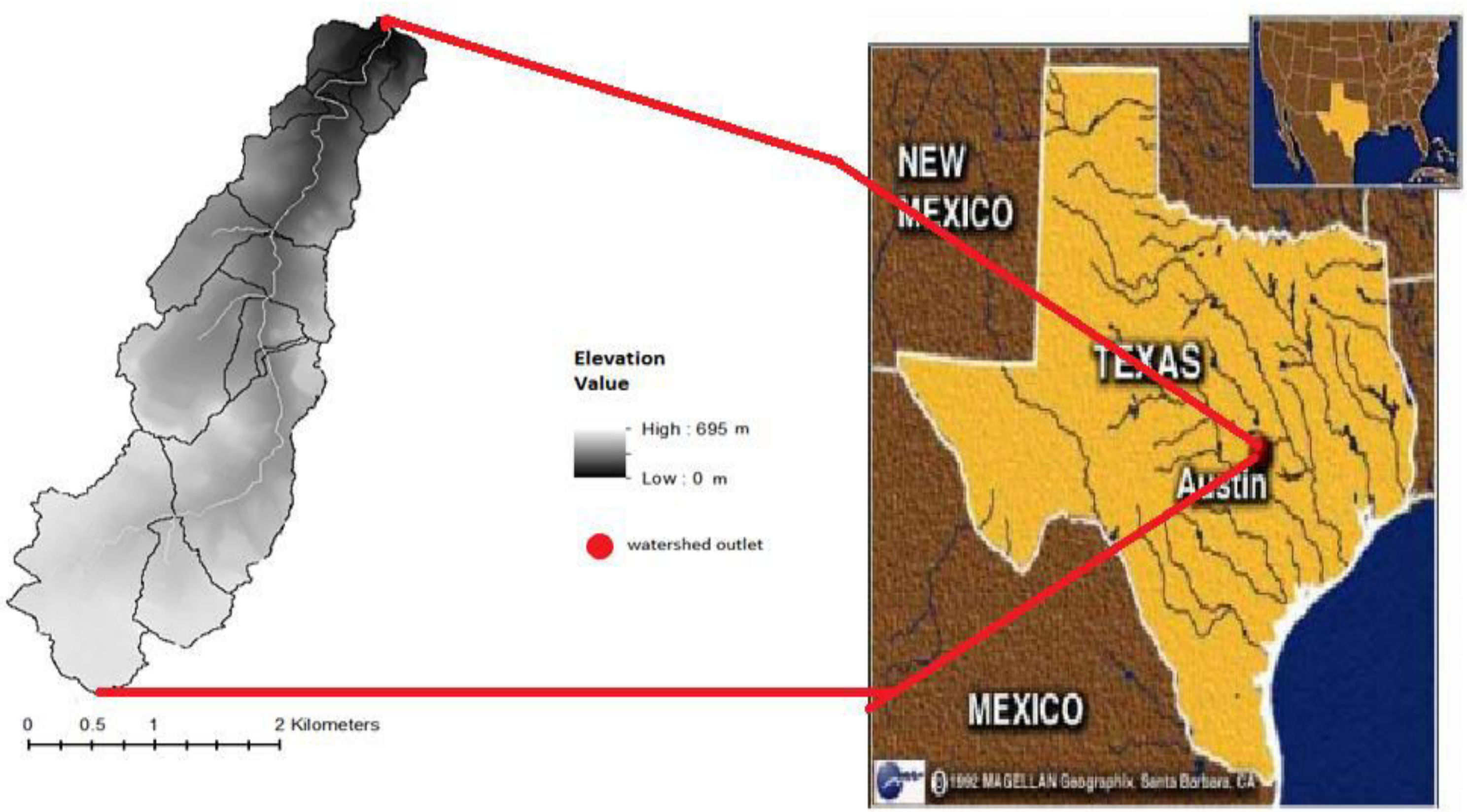
BLUNN CREEK WATERSHED- AN OVERVIEW



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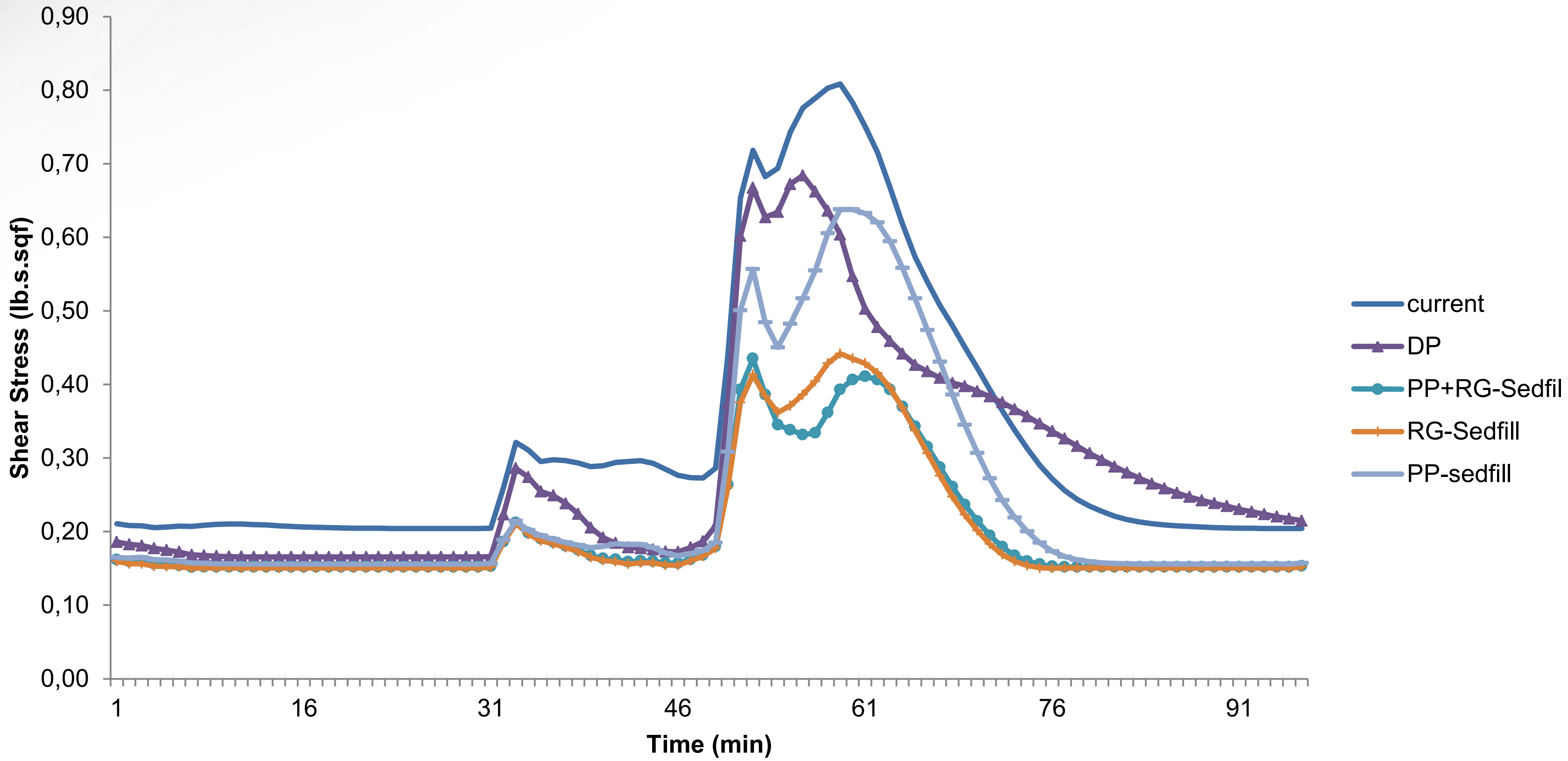
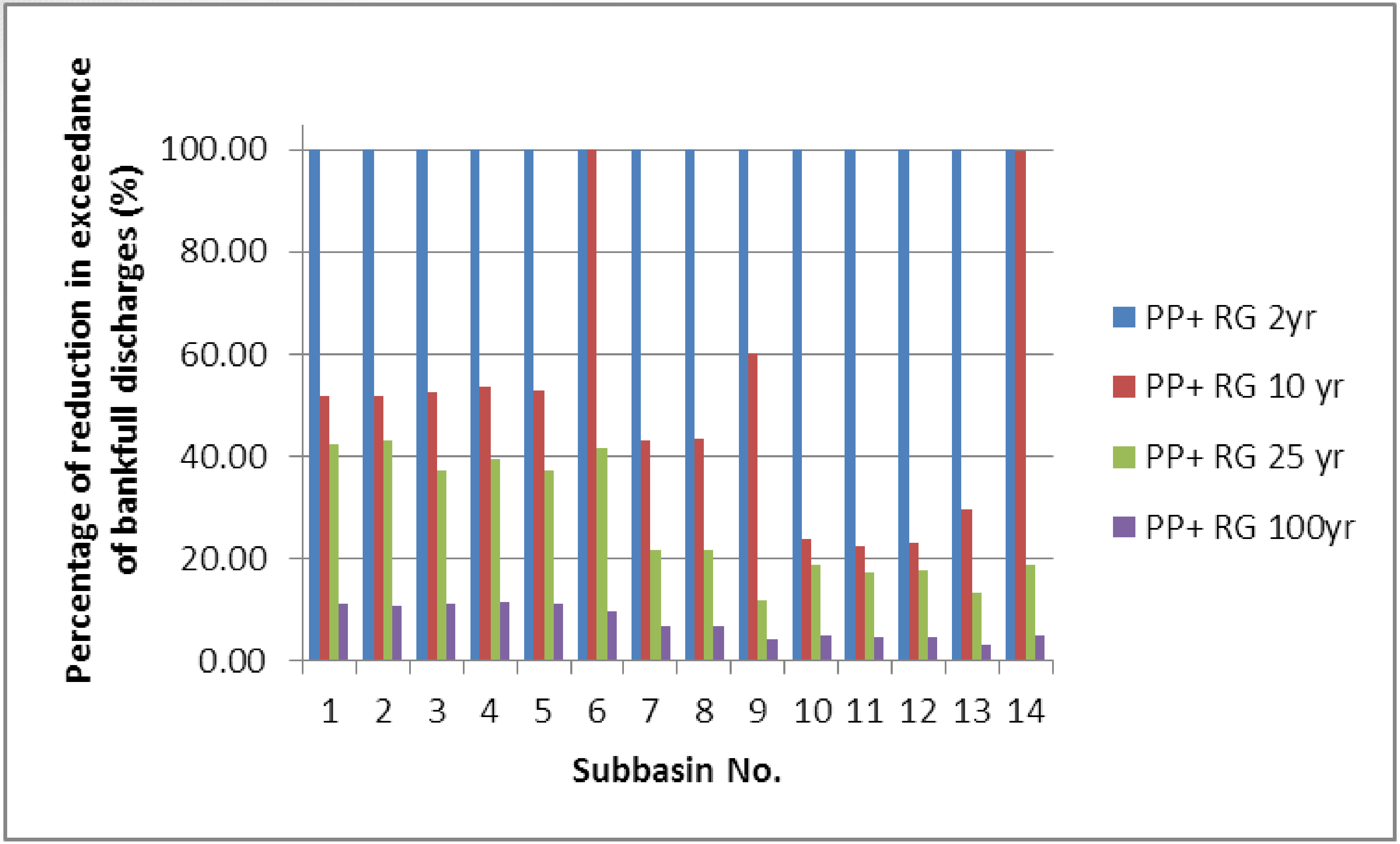
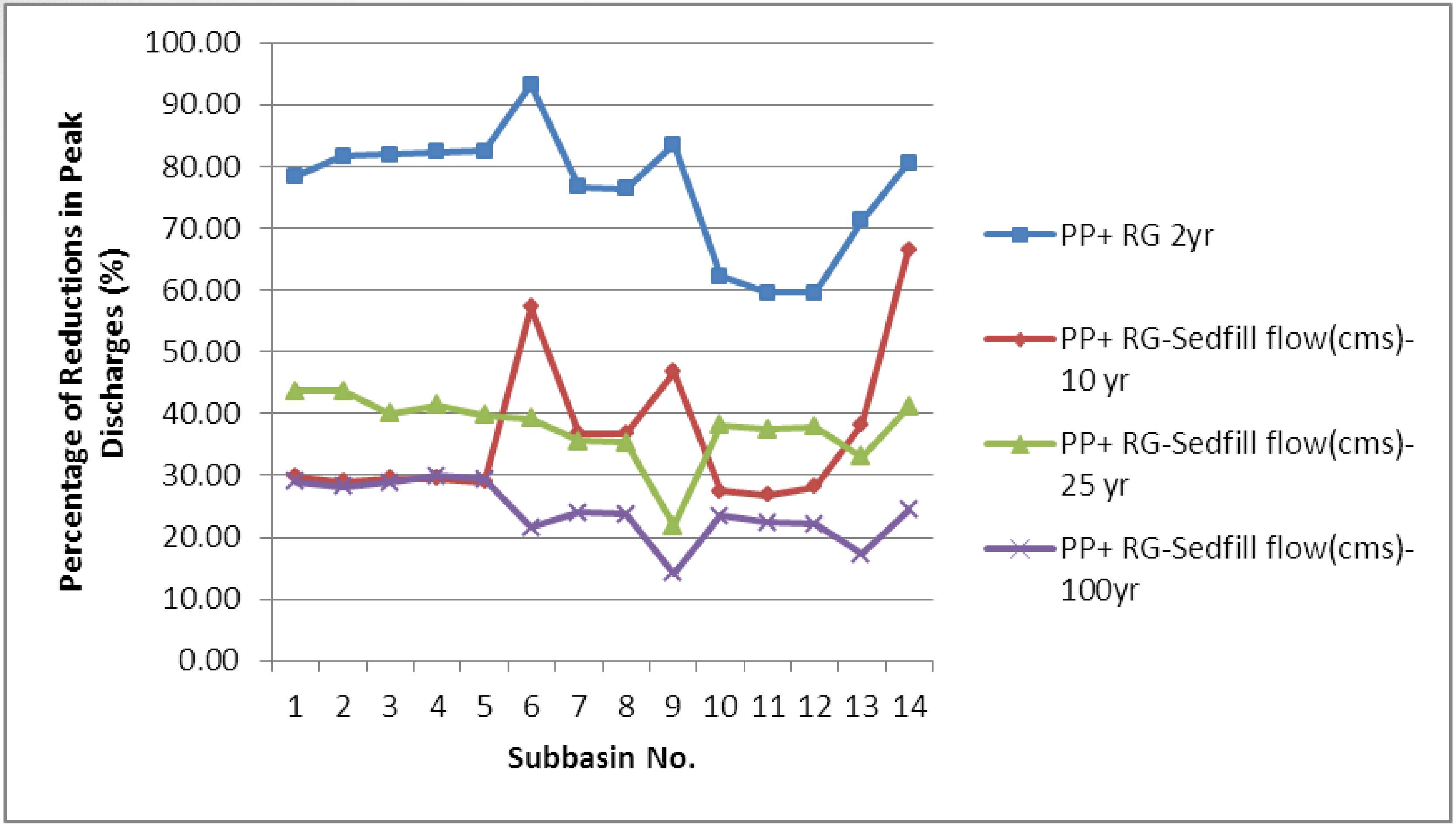
Results of LID on Shear Stress



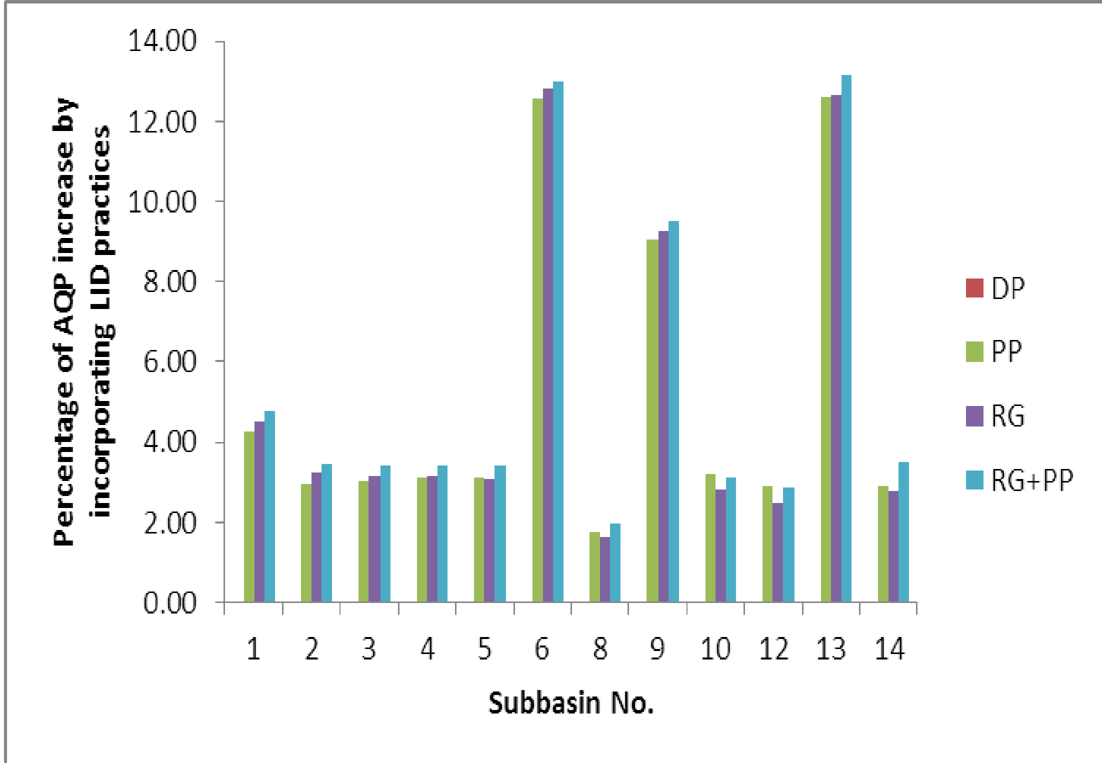
Reduction in flooding due to LID

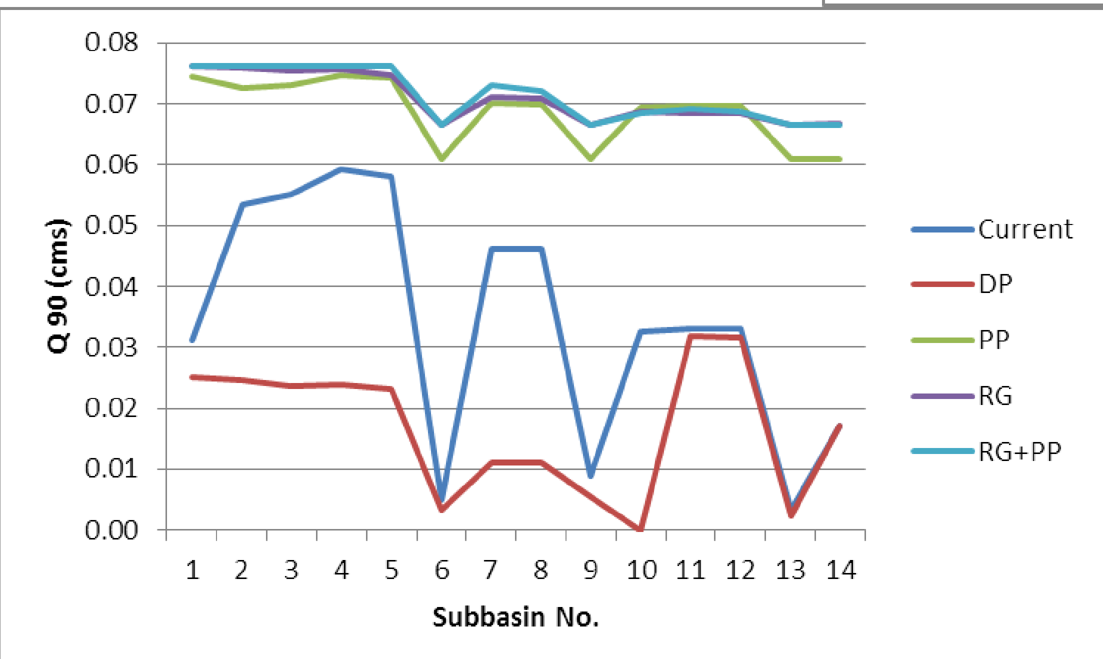


Reduction of Peak Flow



Combining bioretention area with permeable pavement resulted with the greatest percentage of AQP value increase, followed by RG only, PP and DP





Greatest increase in baseflow resulted when combining bioretention area with permeable, followed by RG only, PP and lastly DP

Acknowledgements

- This research was made possible by a CWA 319 (h) NPS grant provided by USEPA and TCEQ
- Texas AgriLife Research for providing funds and the location for the constructed BMPs.
- Modeling studies funded by Texas Sea Grant, USEPA, TCEQ and the City of League City, TX

TEXAS A&M AGRILIFE
RESEARCH | EXTENSION

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Rainwater Harvesting as Stormwater Mitigation

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Associate Professor and Extension Specialist- Water Resources
Biological and Agricultural Engineering
Texas A&M AgriLife Extension

What is Rainwater Harvesting?

- **Rainwater Harvesting** is the capture, diversion, storage and distribution of rainwater for later use or as stormwater mitigation
- Why Rainwater Harvesting
  - Reduces flooding, erosion, and contamination of surface water
  - Slowly release stormwater back into stream or use for irrigation

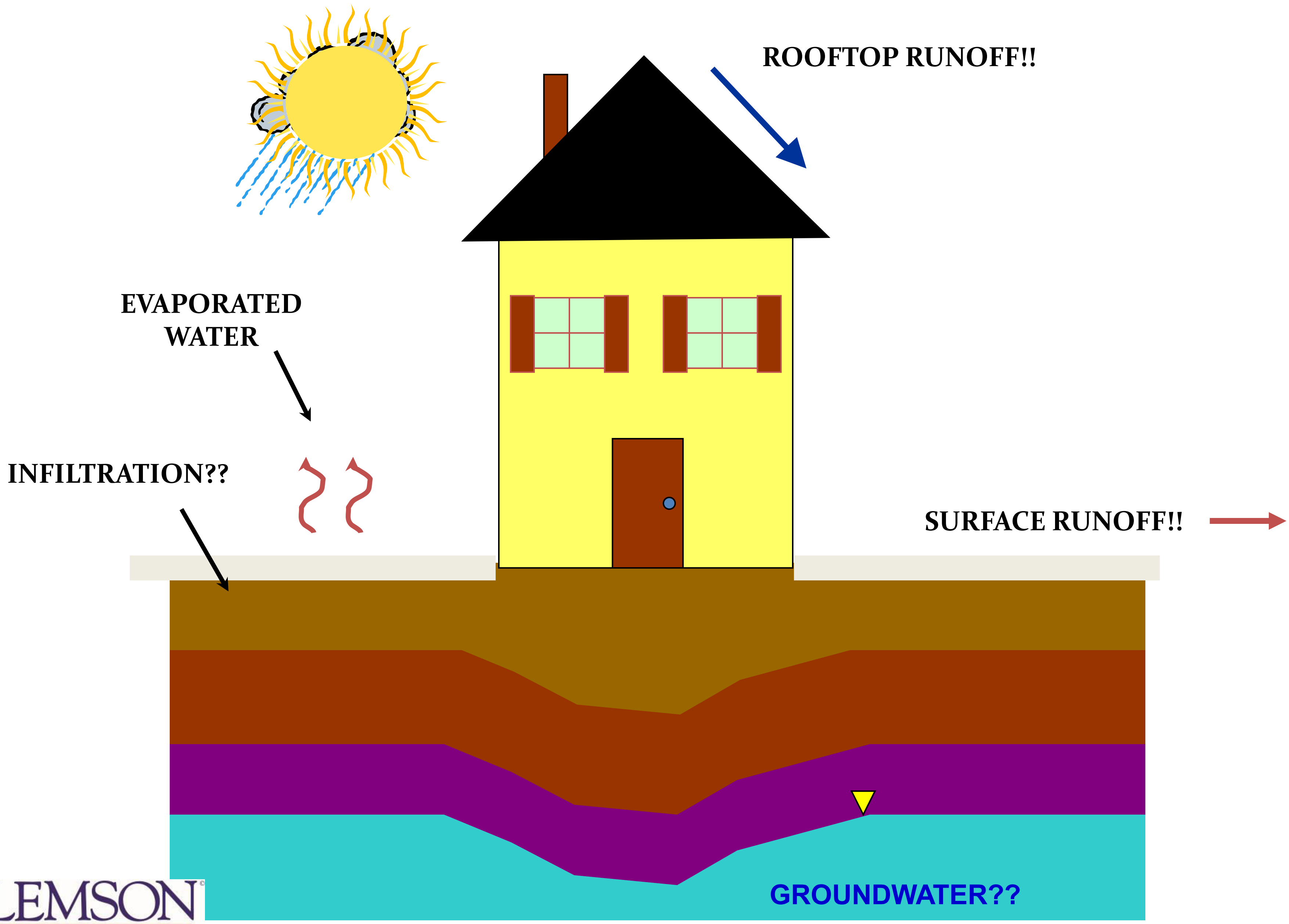
Incentives

- Environmental Stewardship
- Sustainability
- Many municipalities with stormwater utility fees offer a monetary credit for the correct installation and maintenance of a rain garden and/or rainwater harvesting system

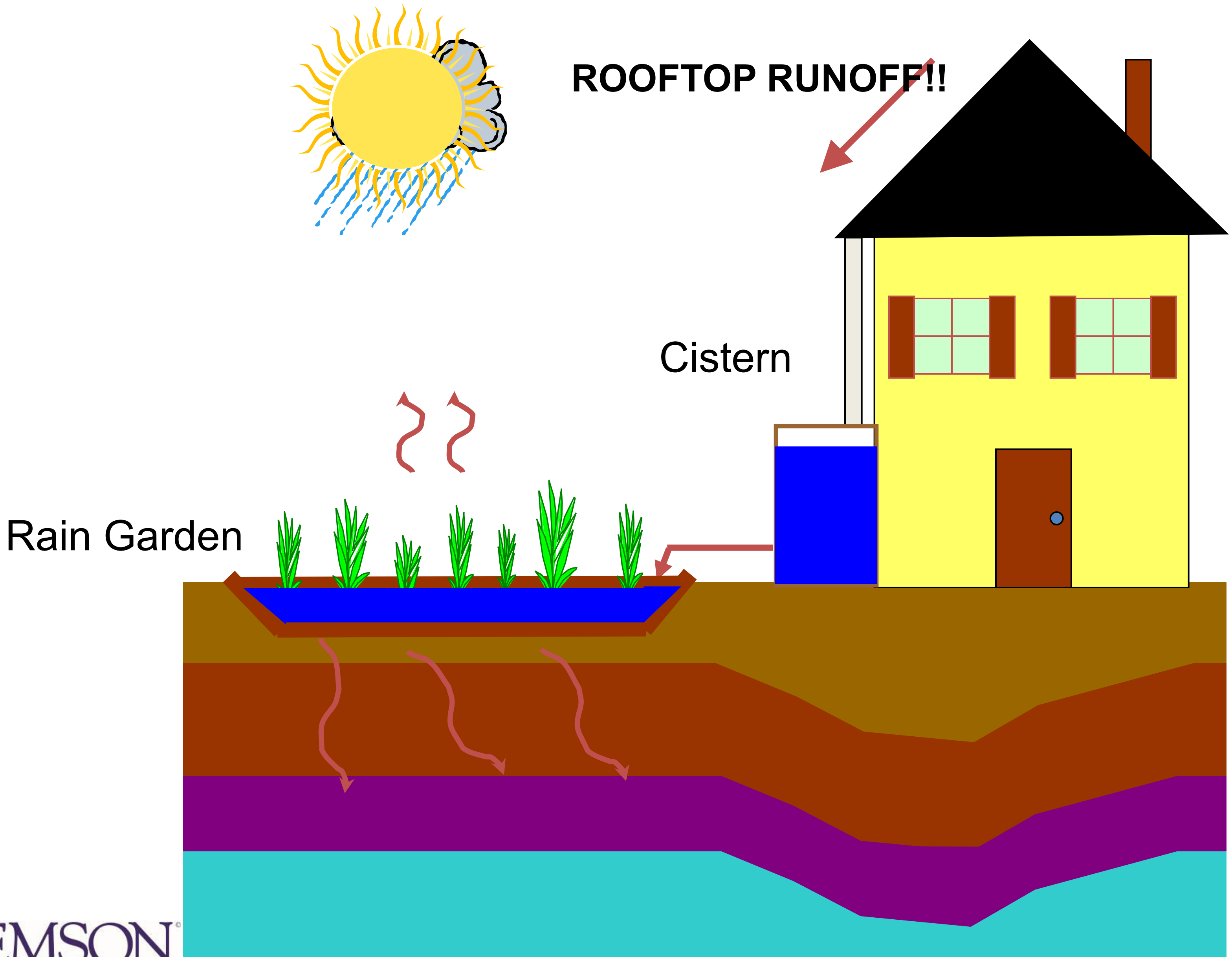
Uses For Collected Rainwater

- Mitigating Stormwater
- Irrigation
  - Landscape
  - Garden
- Vehicle Washing
- Livestock
- Wildlife
- Firefighting

Urban Water Budget – Pavement and Rooftop Scenario



Urban Water Budget – Rainwater Harvesting Scenario



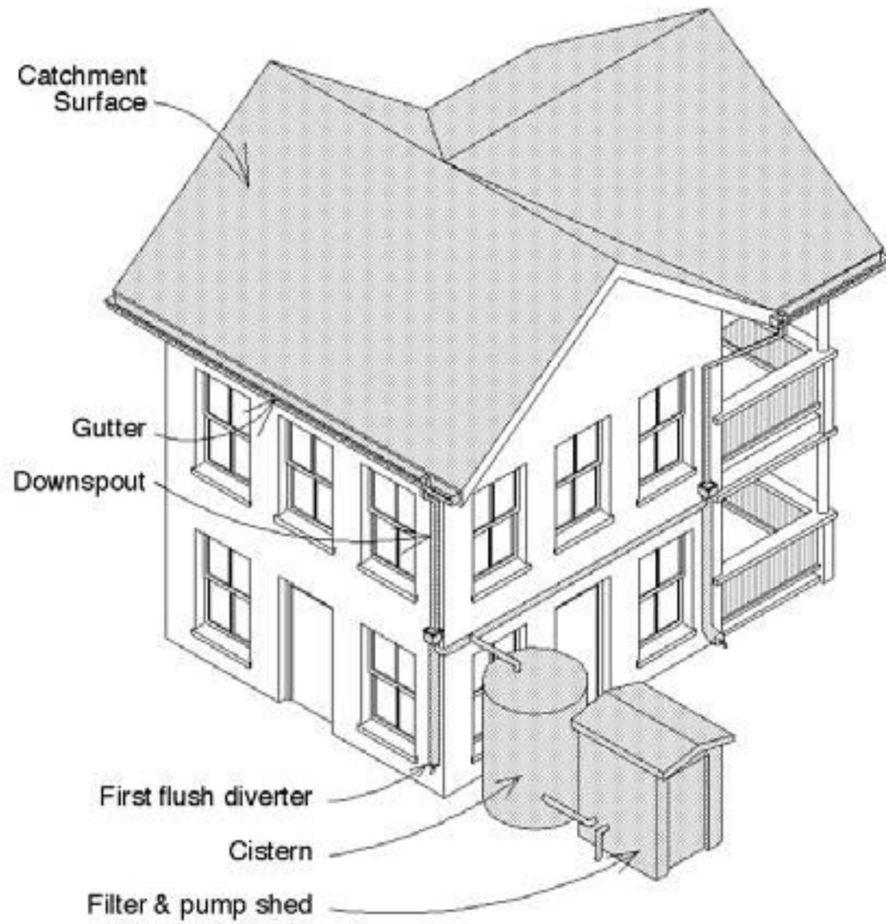
CLEMSON
PUBLIC SERVICE

How Much Rainwater Can I Collect?

- .6 gallons for every square foot roof per 1” rainfall
- 20,000 sq. foot roof X 1" rain = 12,000 gal. water
- 12,000 gal. X 32" rainfall per year= 384,000 gal/yr

Rainwater Harvesting Requirements

- Consist of:
  - Catchment
    - Foot print of roof
  - Conveyance
    - Gutters and Downspouts
  - Storage
    - Tank
  - Treatment
    - Filtration
  - Distribution
    - Drip Irrigation



Calculate Irrigation Requirements for Irrigation

Requirements (gal) = ET (in) x Plant Coefficient x 0.623 x Irrigated Area (sq ft)

Rainwater Harvesting System

Storage

- Containers may be made of polyethylene, fiberglass, wood, concrete, or metal
- underground or above-ground

Underground Storage

Components

- **Leaf filter**
- **Calming Inlet**
  - Keep Sediment Layer From Being Disturbed
- **Overflow Siphon**
  - Creates Vacuum
  - Skims Floating Debris
- **Floating Intake/Extractor**
  - Acts As Intake/Suction For Pump
  - Only Takes The Cleanest Water From The Tank

Rainwater Harvesting System Filter
First Flush Diverter

Irrigation Filter between Cistern and Pump

Mosquitoes

Wildlife Guzzler

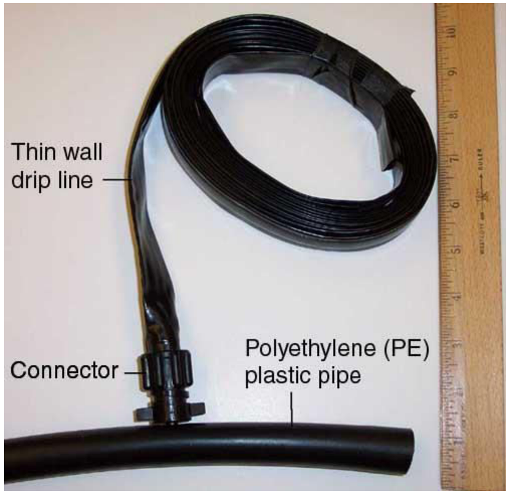
Size Cistern to Site

Rainwater Harvesting System

– Distribution System

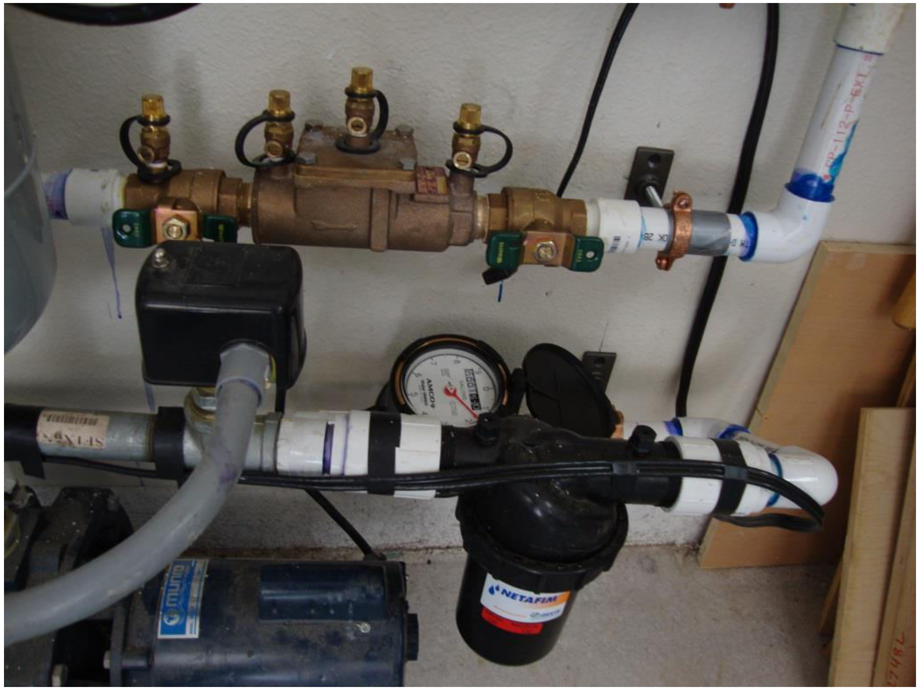
- Distributes water to plants from storage containers
- Use garden hoses, soaker hose, or drip system
- Use pump either electric or solar powered
- If the system is integrated with municipal supply, install a backflow preventer double check valve with an "air gap" or other approved backflow device

Types of Drip Irrigation



Pump and Pressure Tank

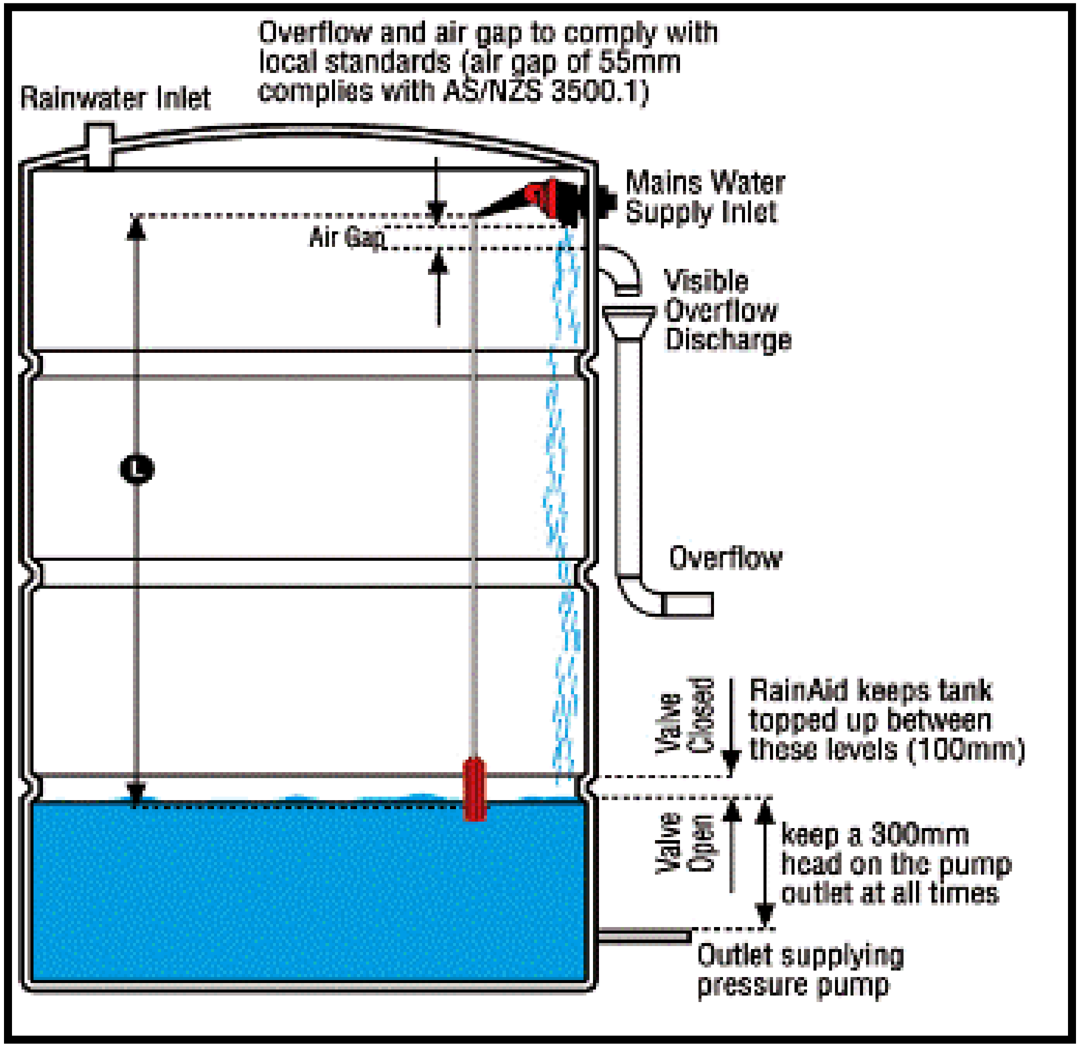
- Shallow well pump
- Pressure tank
- On-Demand Pump



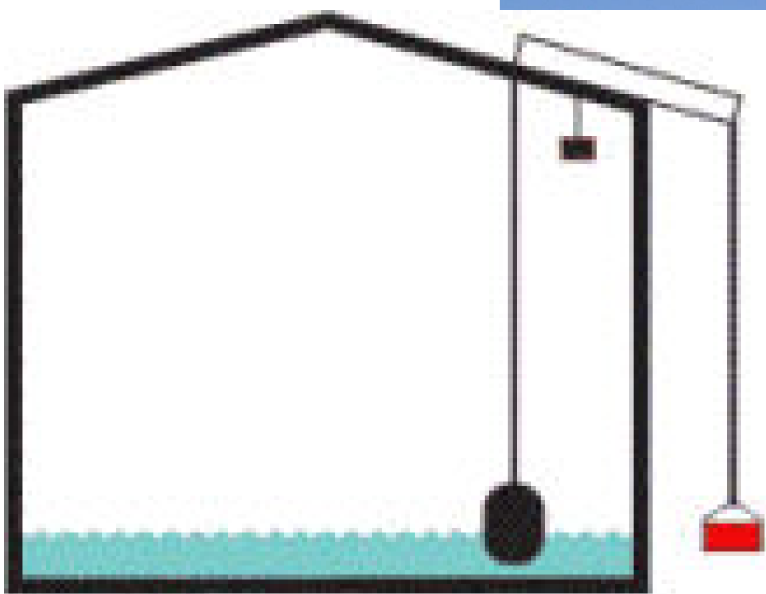
Overflow Pipe

The overflow allows water to run out of the tank when it is full rather than backing up into the gutter

Backup Water



Water Level Indicator



Calculate Stormwater

Calculate Stormwater

Sormwater (gal) = Rainfall (in) x 0.623 x Catchment Area (sq ft)

.6 gallons for every square foot roof per 1” rainfall
20,000 sq. foot roof X 1" rain = 12,000 gal. water
12,000 gal. X 32" rainfall per year= 384,000 gal/yr

For More Information

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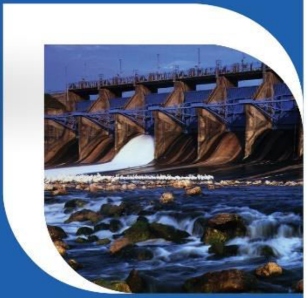
Water Quality Monitoring Results

Angela Kilpatrick

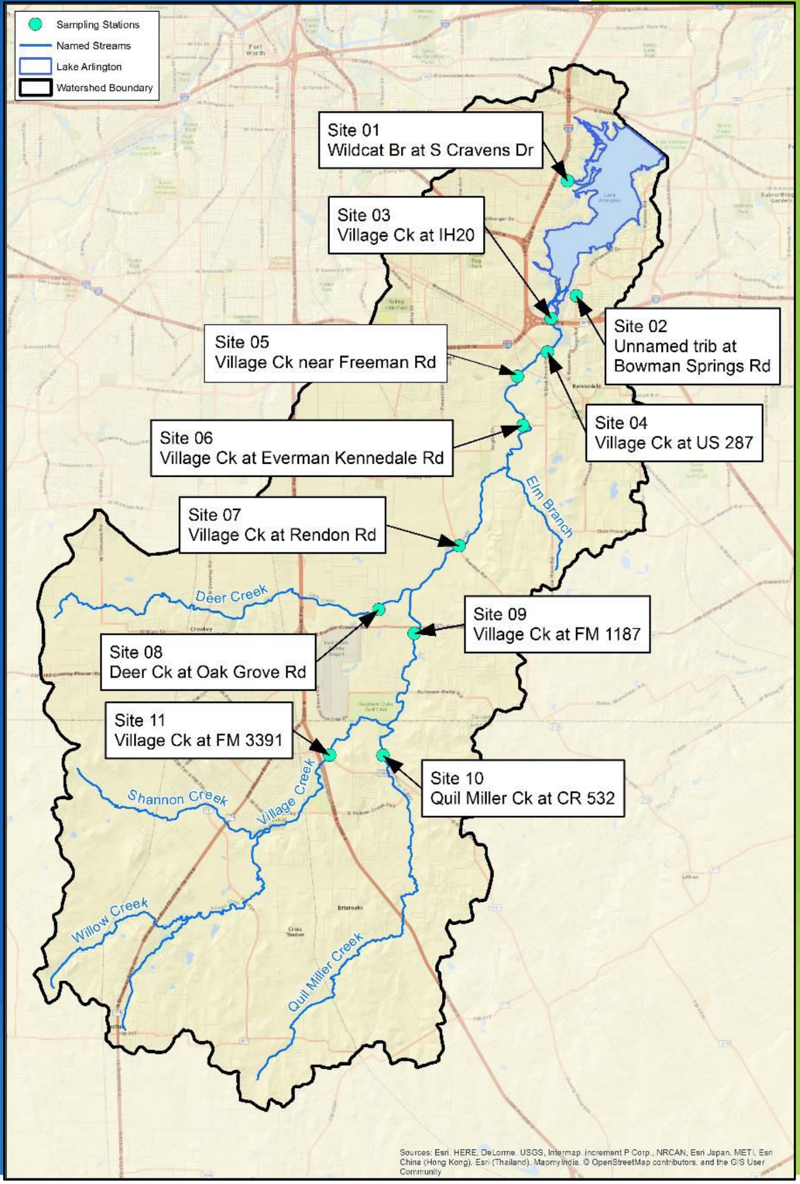
Trinity River Authority

September 22, 2016



Monitoring Plan Review

- All parameters at all 11 stations
- Near the Lake:
  - Wildcat Branch to the west
  - Unnamed trib to the east
  - Top of Lake near IH-20
- On Village Creek
  - 5 sites, bracketing specific land uses and water inputs
- Major tributaries
  - Deer Creek – urban upstream
  - Quil Miller Creek – rural/agriculture

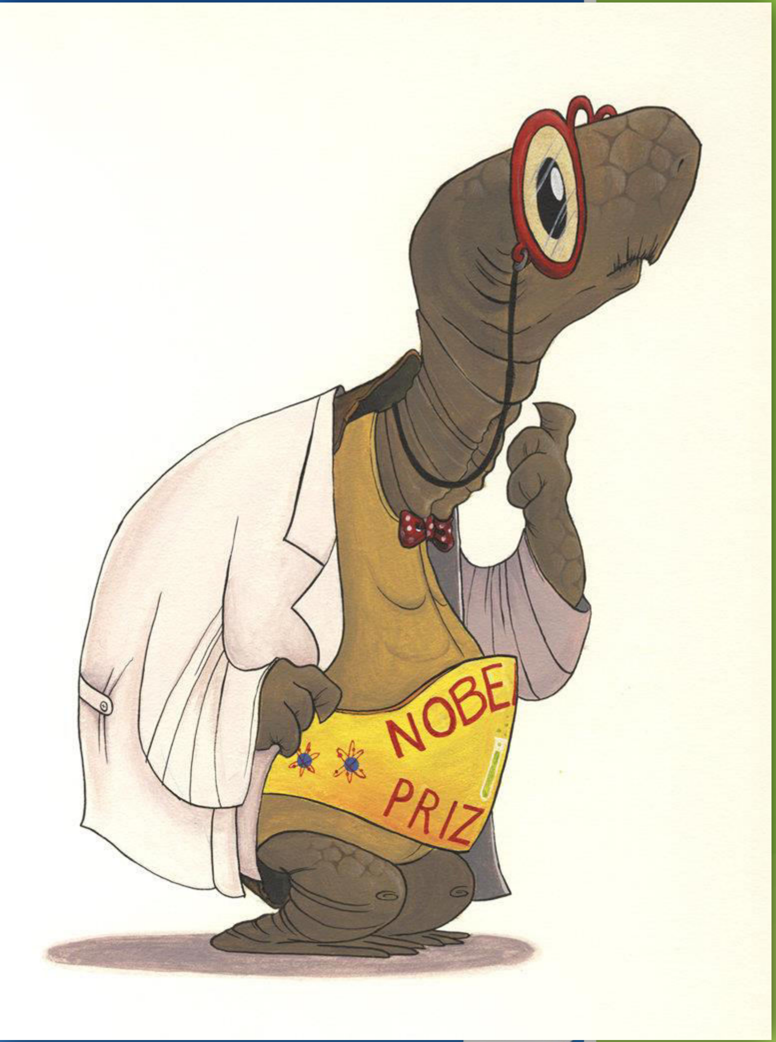


TRA-CRWS Laboratory

- The CRWS Lab is accredited by the National Environmental Laboratory Accreditation Program (NELAP) through TCEQ
- Samples collected by PES staff are dropped off at CRWS lab for analysis of:
  - *E. coli*
  - Nitrate, Nitrite, Total Kjeldahl Nitrogen
  - Total Phosphorus, Orthophosphate
  - Chlorophyll a
  - TDS, TSS, VSS

Preliminary Analysis Results

- Not yet submitted to TCEQ's Water Quality Monitoring Information System (SWQMIS) database
- Still undergoing quality control analyses
- Not yet enough data to apply statistical analysis (i.e., trend analysis)
- Data will be used to develop the Village Creek-Lake Arlington WPP



Evaluation Criteria

Analytical results were compared to TCEQ's water quality standards and screening levels to determine if values exceeded criteria

Site-specific Water Quality Criteria for the Village Creek-Lake Arlington Watershed (TCEQ)

Parameter	Segment ID	
	0828	0828A
Cl-1 (mg/L)	100	100
SO4-2 (mg/L)	100	-
TDS (mg/L)	300	300
DO (mg/L) grab minimum	3.0	2.0
DO (mg/L) 24 hour average	5.0	3.0
DO (mg/L) 24 hour minimum	3.0	2.0
pH range	6.5-9.0	6.5-9.0
E. coli #/100ml	126	126
Temperature (°F; °C)	95; 35	95; 35

Texas Nutrient Screening Levels and EPA Nutrient Reference Criteria

Parameter		TCEQ Screening Levels		EPA Reference Criteria				Other Sources
		Lake/Reservoir	Stream	Lake/Reservoir		Stream		
TKN	(mg/L)	-	-	0.38[a]	0.41[b]	0.3[a]	0.4[b]	
NO_2	(mg/L)	-	-	-	-	-	-	0.02[c]
NO_3	(mg/L)	0.37	1.95	-	-	-	-	
NO_2+NO_3	(mg/L)	-	-	0.017[a]	0.01[b]	0.125[a]	0.078[b]	
TP	(mg/L)	0.20	0.69	0.02[a]	0.019[b]	0.037[a]	0.038[b]	
OP	(mg/L)	0.05	0.37	-	-	-	-	
Chl-a[d]	(µg/L)	26.7	14.1	5.18[a]	2.875[b]	0.93[a]	1.238[b]	

[a] Reference conditions for aggregate Ecoregion IX waterbodies, upper 25th percentile of data from all seasons, 1990-1999.

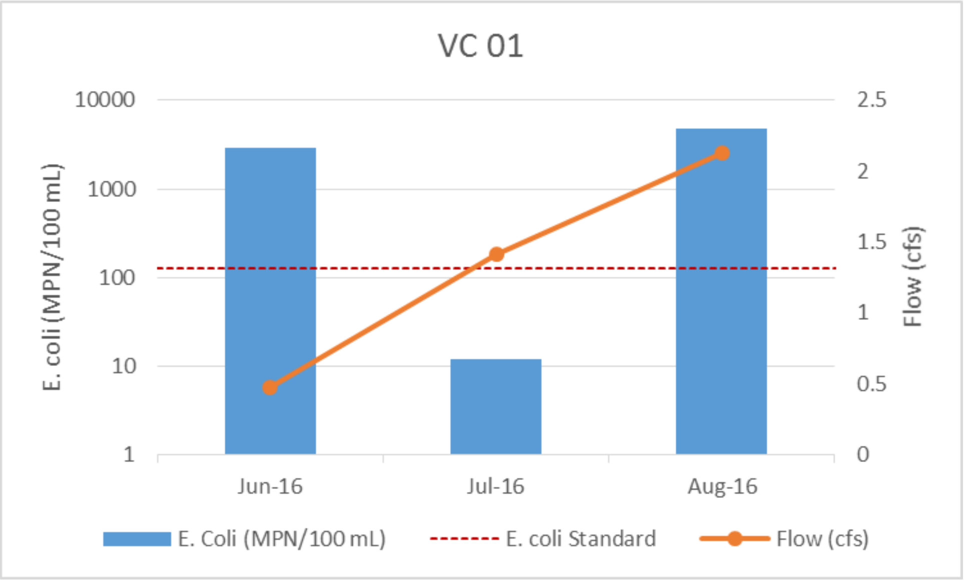
[b] Reference conditions for level III Ecoregion 29 waterbodies, upper 25th percentile of data from all seasons.

[c] For nitrite, concentrations above 0.02 mg/L (ppm) usually indicate polluted waters (Mesner, N., J. Geiger. 2010. Understanding Your Watershed: Nitrogen. Utah State University, Water Quality Extension.

[d] Chlorophyll a, as measured by Spectrophotometric method with acid correction.

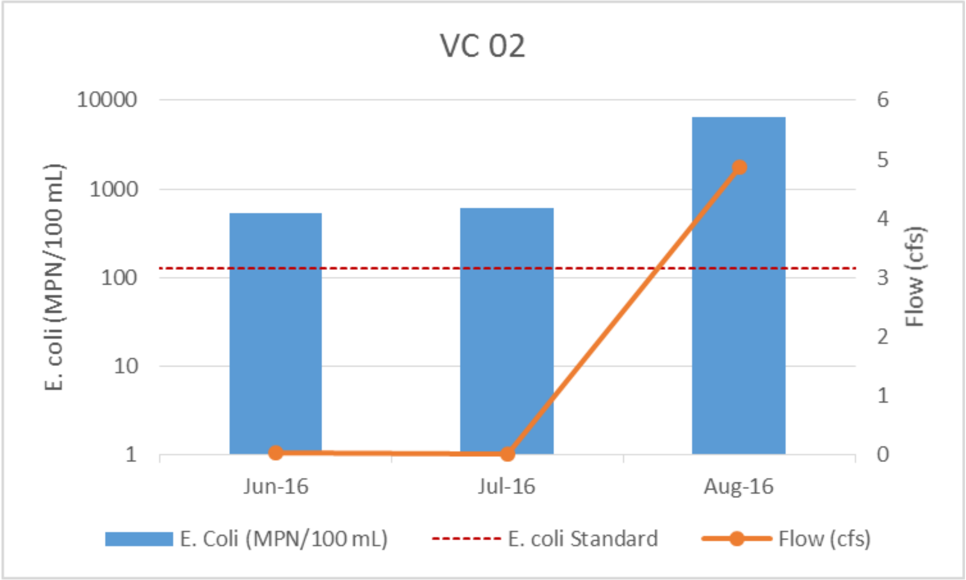
Site 1 – Wildcat Branch at Cravens

Site ID 10793	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/29/2016	17	2909	0.25	<0.05	1.08	0.04	0.14	164	10	<3
7/19/2016	17	12	<0.05	<0.05	0.65	<0.02	0.04	244	7	3
8/15/2016	4	>4839	0.33	<0.05	0.82	0.03	0.09	187	12	<8



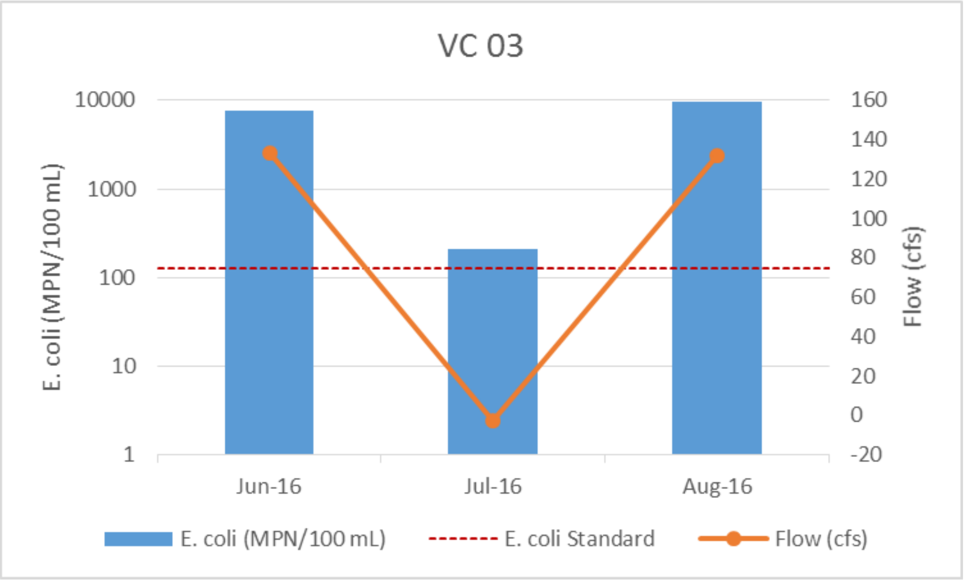
Site 2 – Unnamed trib at Bowman Springs Rd

Site ID 10798	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/28/2016	11	534	0.2	<0.05	0.38	<0.02	0.02	1304	<2	<2
7/20/2016	<3	612	<0.05	<0.05	0.36	<0.02	0.02	1573	4	<2
8/17/2016	3	6510	0.4	<0.05	0.68	<0.02	0.06	240	19	<15



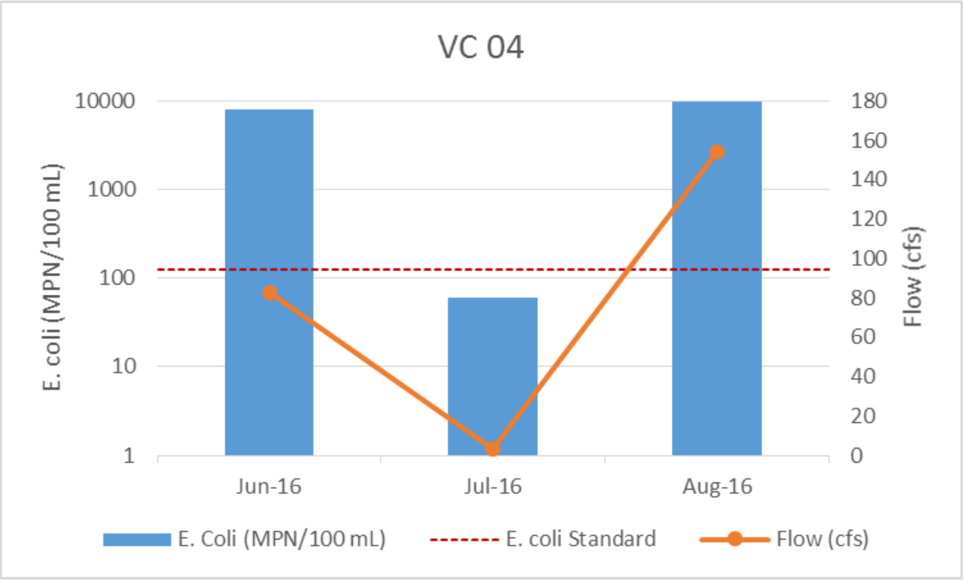
Site 3 – Village Creek at IH-20

Site ID 10780	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/29/2016	9	7701	0.62	<0.05	0.96	0.11	0.35	233	116	<14
7/20/2016	12	212	0.14	<0.05	0.59	<0.02	0.05	238	20	3
8/15/2016	6	>9678	0.23	<0.05	0.9	0.02	0.28	192	128	12



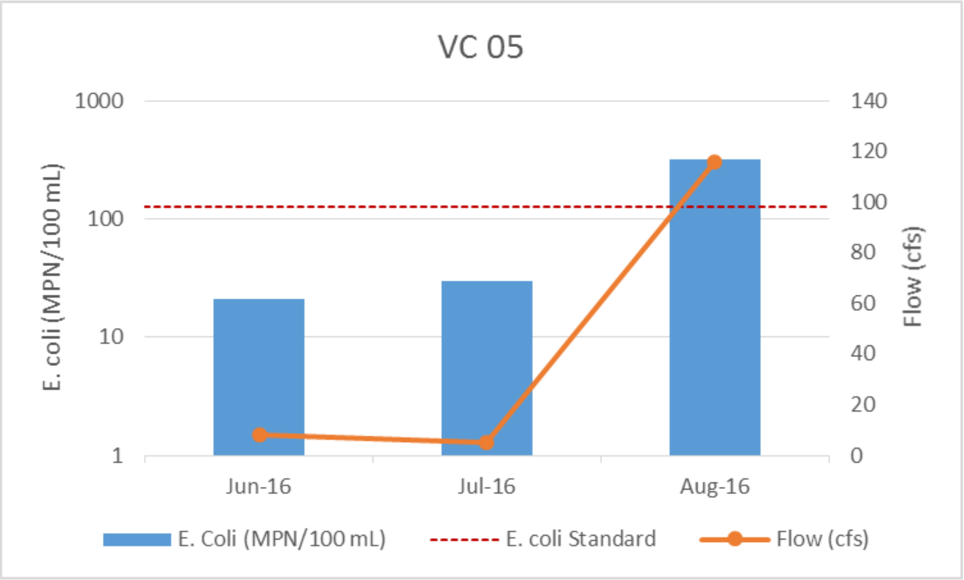
Site 4 – Village Creek at US-287 BUS

Site ID 10781	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/28/2016	11	7945	0.37	<0.05	0.61	<0.02	0.12	304	54	<6
7/20/2016	5	59	0.2	<0.05	0.42	<0.02	0.04	167	9	<2
8/15/2016	8	>9678	0.28	<0.05	0.88	0.04	0.33	179	152	<16



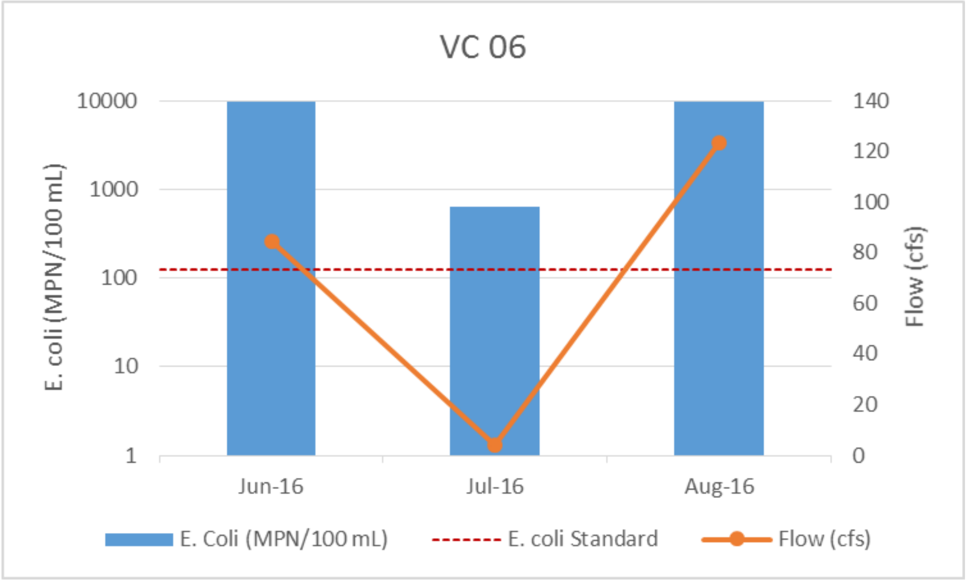
Site 5 – Village Creek near Freeman Dr

Site ID 21762	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
7/12/2016	6	21	0.17	<0.05	0.47	0.02	0.04	152	8	<2
7/20/2016	<3	30	0.23	<0.05	0.42	<0.02	0.03	191	5	<2
8/17/2016	9	323	0.33	<0.05	0.45	<0.02	0.05	146	21	<9



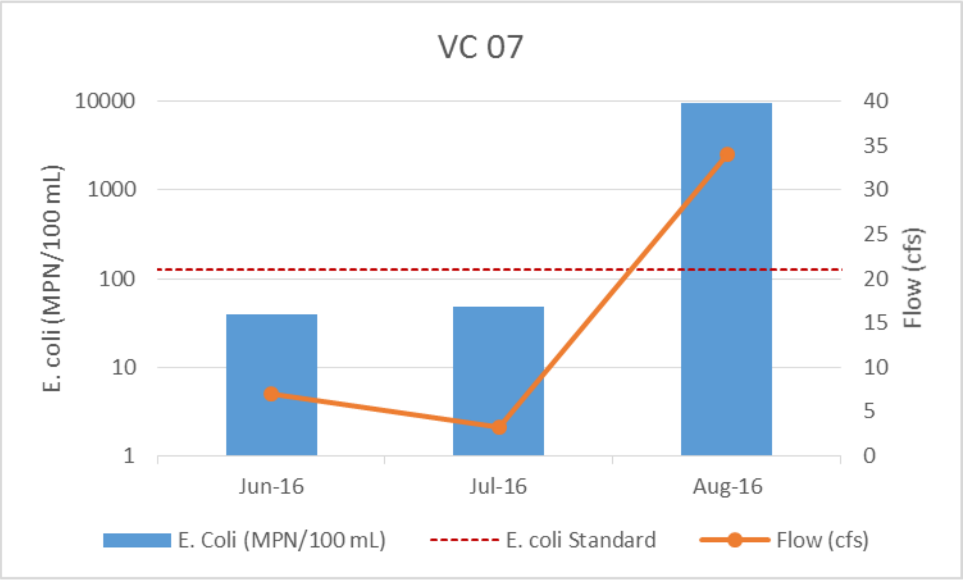
Site 6 – Village Creek at Everman-Kennedale Rd

Site ID 13761	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/28/2016	7	>9678	0.44	<0.05	0.72	<0.02	0.17	276	87	<11
7/20/2016	3	643	<0.05	<0.05	0.21	<0.02	<0.02	481	5	<2
8/15/2016	8	>9678	0.35	<0.05	0.88	0.06	0.4	190	196	<20



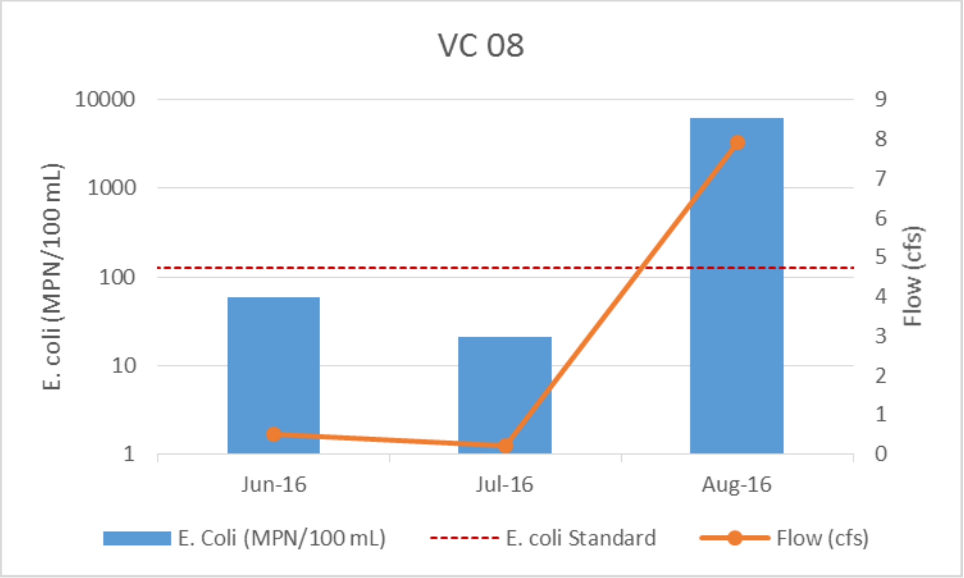
Site 7 – Village Creek at Rendon Rd

Site ID 10786	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/27/2016	<3	39	0.14	<0.05	0.45	<0.02	0.02	509	5	<2
7/20/2016	4	48	<0.05	<0.05	0.37	<0.02	<0.02	461	4	<2
8/15/2016	4	>9678	0.33	<0.05	0.81	0.07	0.25	202	58	<19



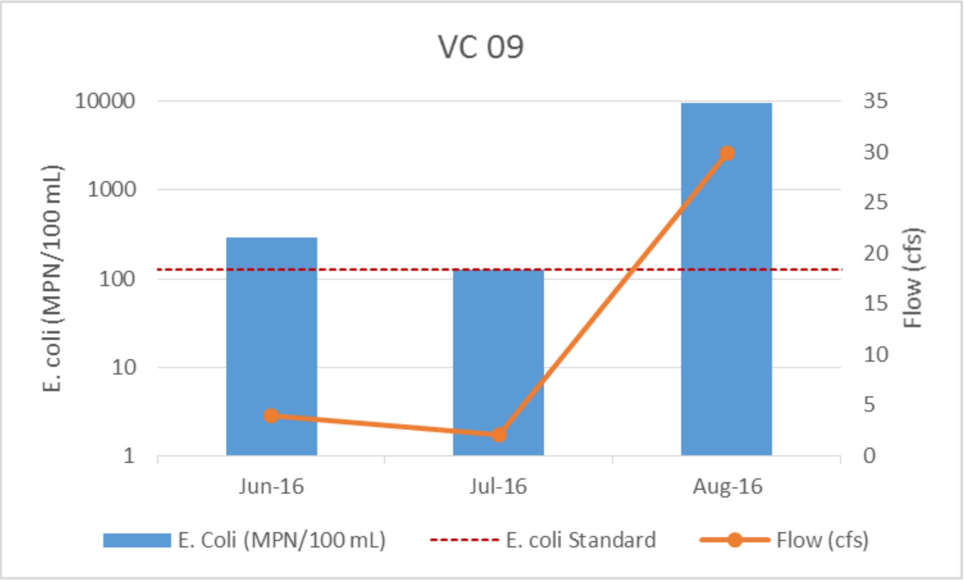
Site 8 – Deer Creek at Oak Grove Rd

Site ID 10805	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/27/2016	4	58	0.54	<0.05	0.49	<0.02	<0.02	350	4	<2
7/19/2016	4	21	0.15	<0.05	0.45	<0.02	<0.02	309	5	<2
8/15/2016	8	6212	0.39	<0.05	0.71	0.04	0.26	212	137	<14



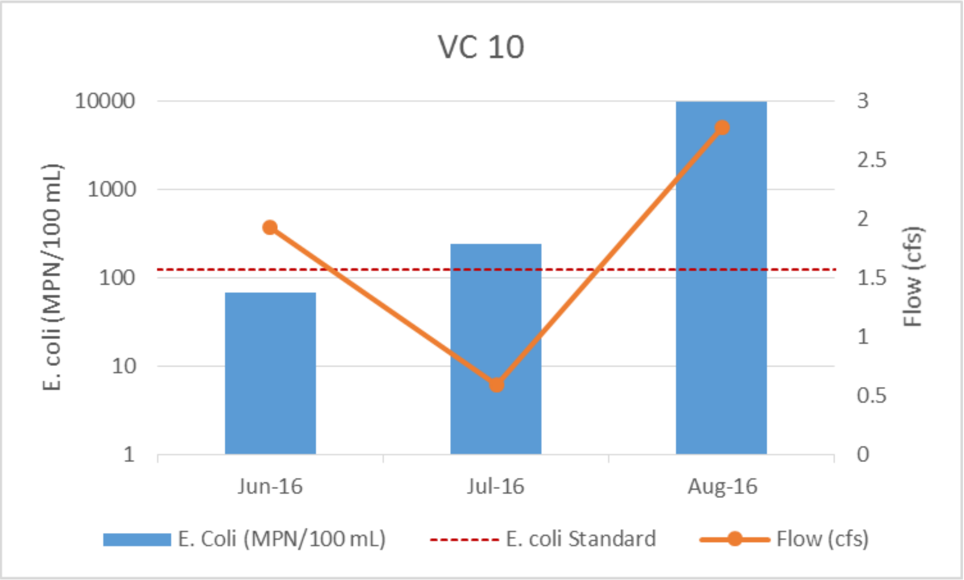
Site 9 – Village Creek at FM 1187

Site ID 10785	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/27/2016	5	289	0.31	<0.05	0.42	<0.02	0.03	558	8	<2
7/19/2016	<3	127	0.4	<0.05	0.5	<0.02	0.02	501	4	<2
8/15/2016	8	>9678	0.37	<0.05	0.83	0.08	0.28	204	54	<17



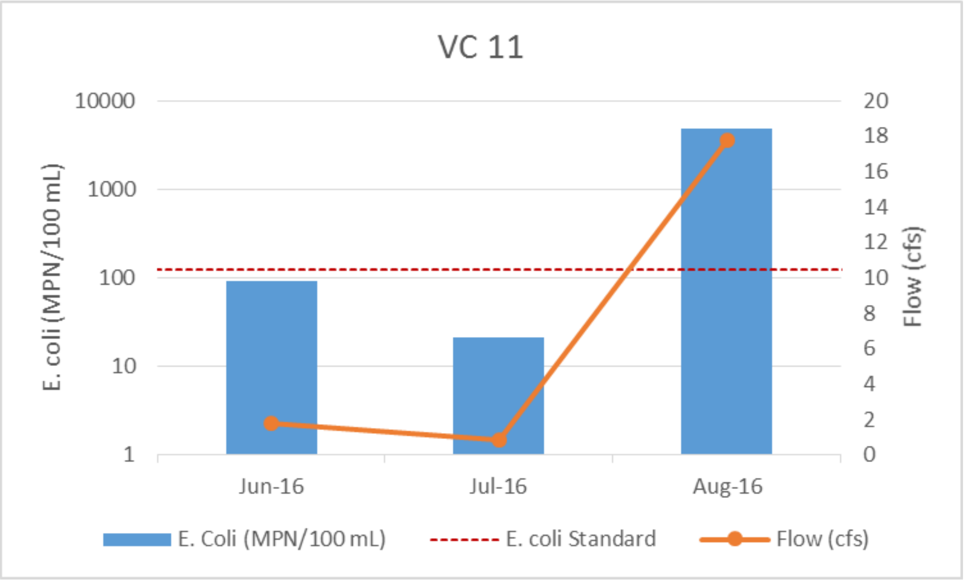
Site 10 – Quil Miller Creek at CR 532

Site ID 21759	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/27/2016	<3	68	0.29	<0.05	0.39	0.07	0.05	676	3	<2
7/19/2016	<3	245	0.12	<0.05	0.26	0.04	0.05	613	4	<2
8/15/2016	<3	>9678	0.43	<0.05	0.99	0.17	0.38	234	54	<14



Site 11 – Village Creek at FM 3391

Site ID 21763	Chl-a (ug/L)	E. Coli (MPN/100 mL)	Nitrate-Nitrogen (mg/L)	Nitrite-Nitrogen (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorous (mg/L)	TDS (mg/L)	TSS (mg/L)	VSS (mg/L)
6/27/2016	<3	92	2.45	0.07	0.67	0.1	0.14	553	8	<2
7/19/2016	<3	21	<0.05	<0.05	0.41	0.18	0.2	515	8	<2
8/15/2016	6	>4839	0.34	<0.05	0.72	0.13	0.22	158	40	<8



Moving Forward

- Continue to analyze water quality samples at TRA-CRWS through May 2017
- TRA will run statistical and load duration curve analysis using CRWS data

Questions?

http://www.trinityra.org/lakearlingtonvillagecreek

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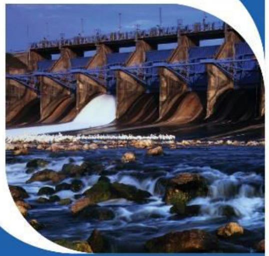
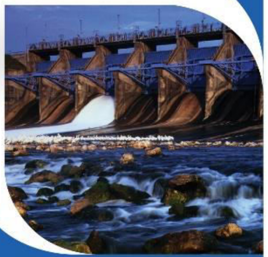


Upcoming Events and Path Forward

Aaron Hoff
Trinity River Authority
September 22, 2016



Future Events and Meetings

- Texas AgriLife Extension
  - Pond Management Workshop
- Lone Star Healthy Streams
  - Winter 2017
- Septic System Maintenance Workshop
  - Spring 2017
- 2^{nd} Steering Committee Meeting
  - Municipal BMPs “Think Tank”
- Next Group Meeting
  - Tentative for January 19, 2017
  - Tentative Topics
    - Sampling update
    - Agricultural BMPs
    - Lawn care/soil management
    - Review a sample WPP

Open Comment Period

If you have additional concerns or comments, please send them to:

Aaron Hoff

Trinity River Authority

hoffa@trinityra.org

817.493.5581

http://www.trinityra.org/lakearlingtonvillagecreek