Overview of Stormwater Green Infrastructure Practices and Their Maintenance

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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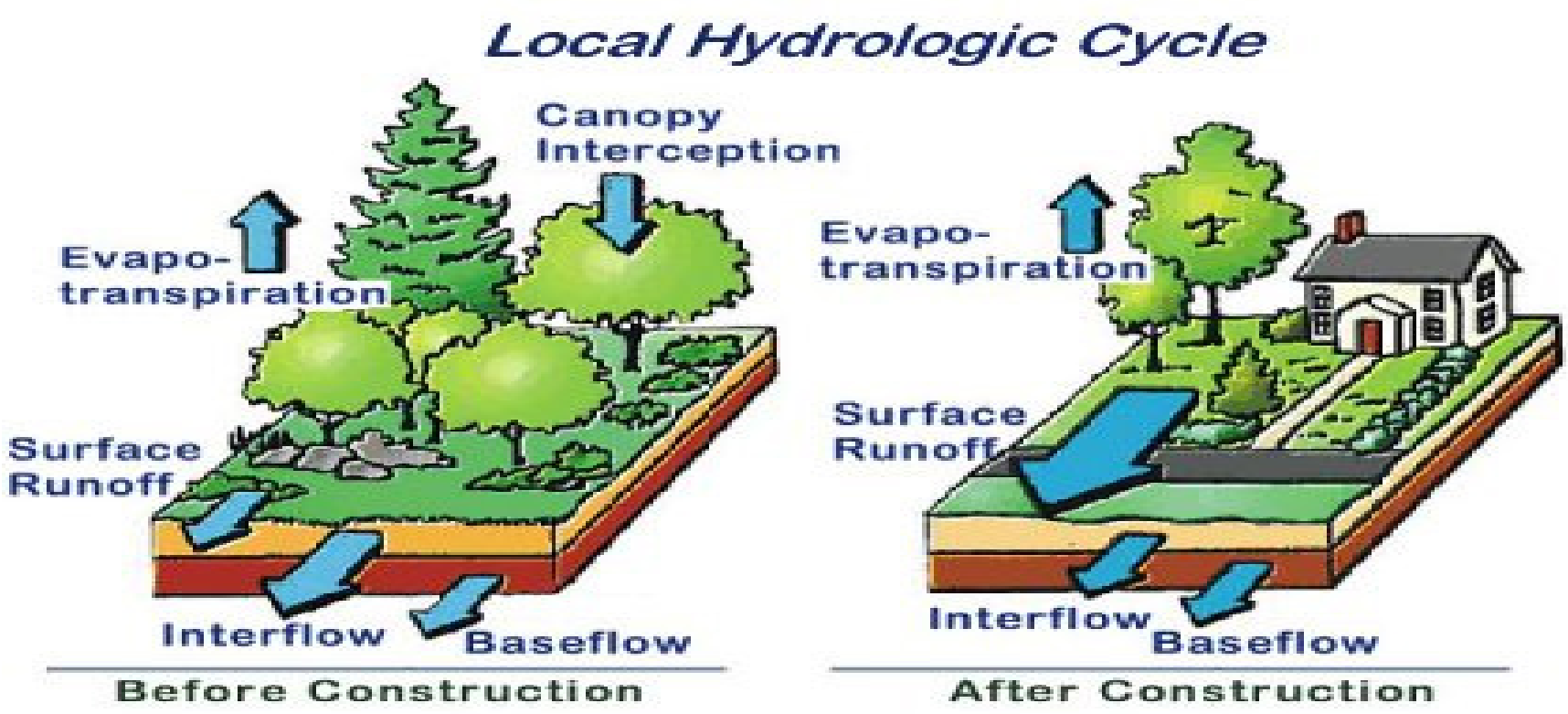
Urban vs. Natural



Why is Stormwater a Concern?

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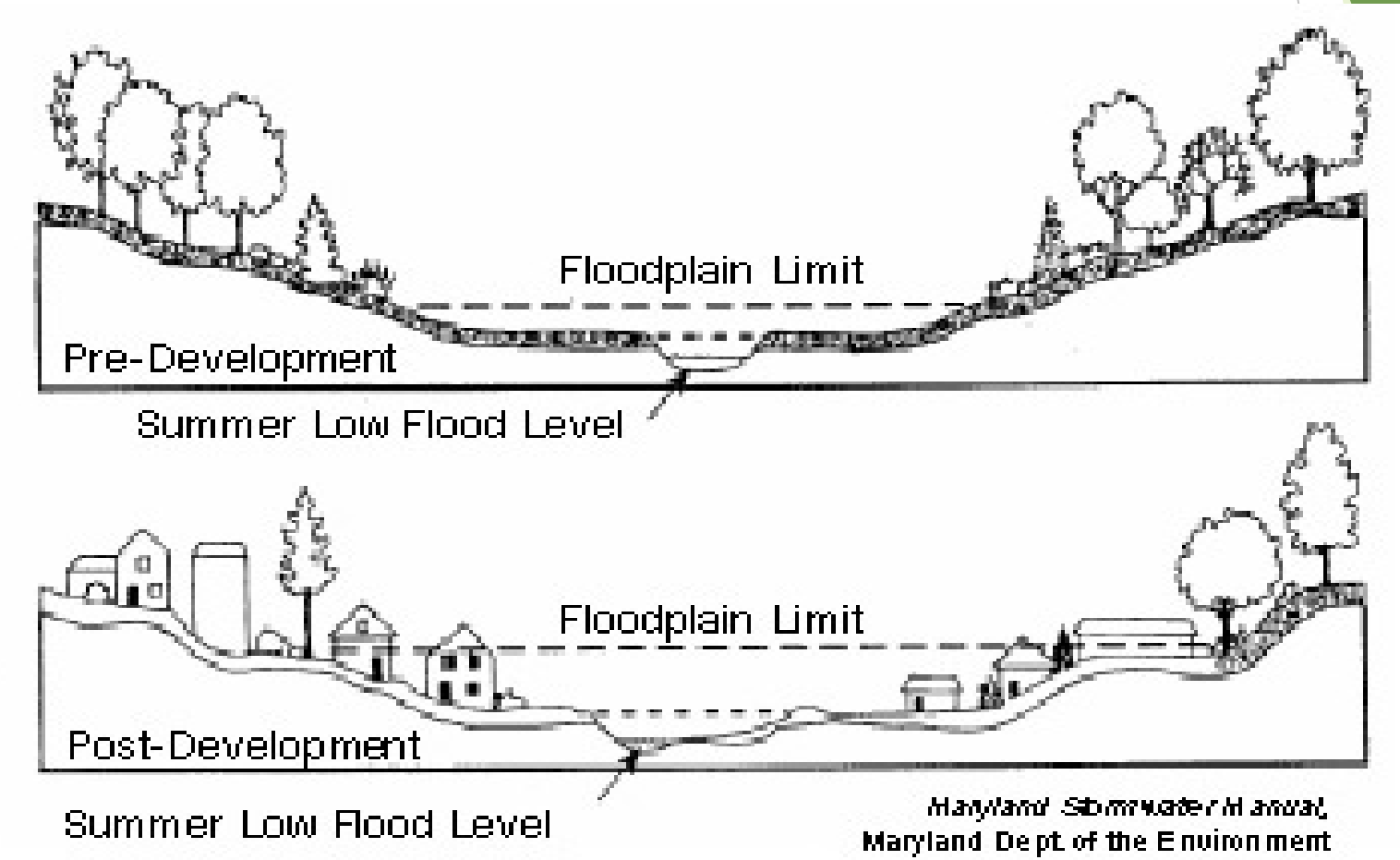


Why is Stormwater a Concern?

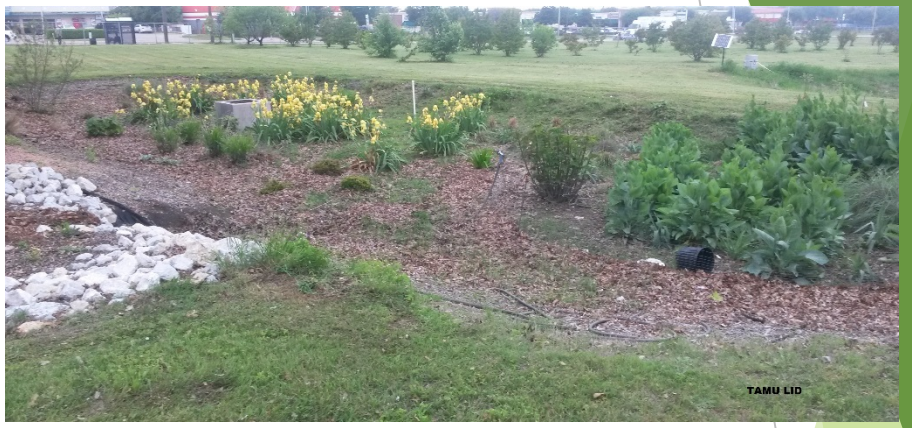
Eutrophication

- 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.

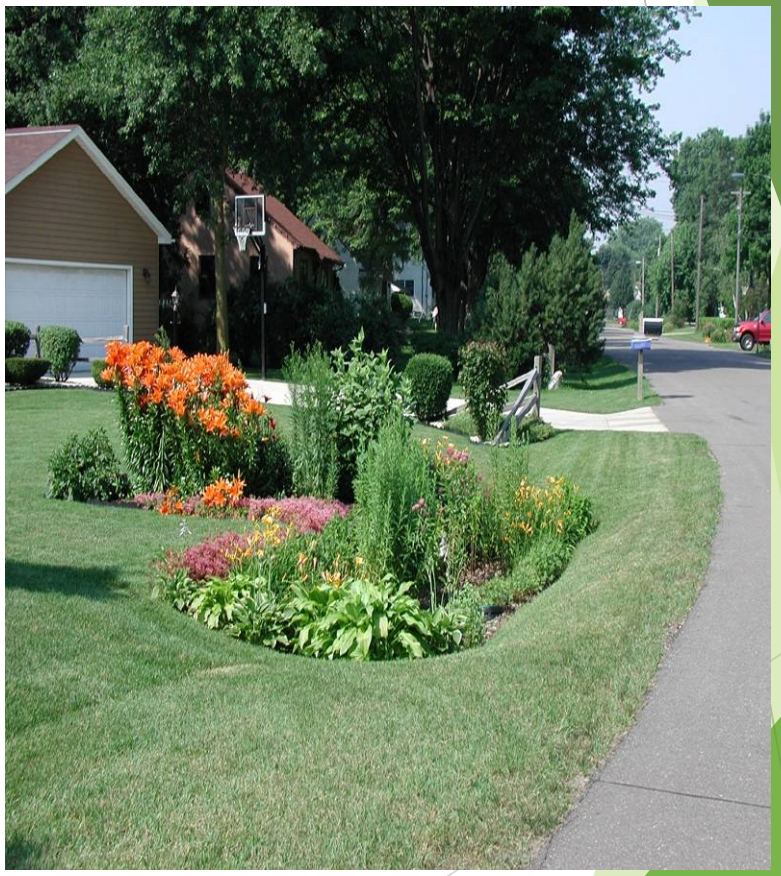
Green Stormwater Infrastructure

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



What is a Rain Garden (Bioretention)?

A rain garden is a beautiful landscape feature consisting of a planted shallow depression that collects rainwater runoff from roofs, parking lots and other impervious surfaces.



Home Rain Garden

Bioretention in Parking Lot

EPA.gov

Bioretention in Road Median

What is Porous Pavement?

- Porous pavement is a permeable pavement surface with a gravel reservoir underneath.
  - it temporarily stores surface runoff before infiltrating it into the subsoil
  - provides water quality treatment
  - often appears as traditional asphalt or concrete but is without "fine" materials
  - could also allow for grass growth

Types of Permeable Pavement

Paver blocks

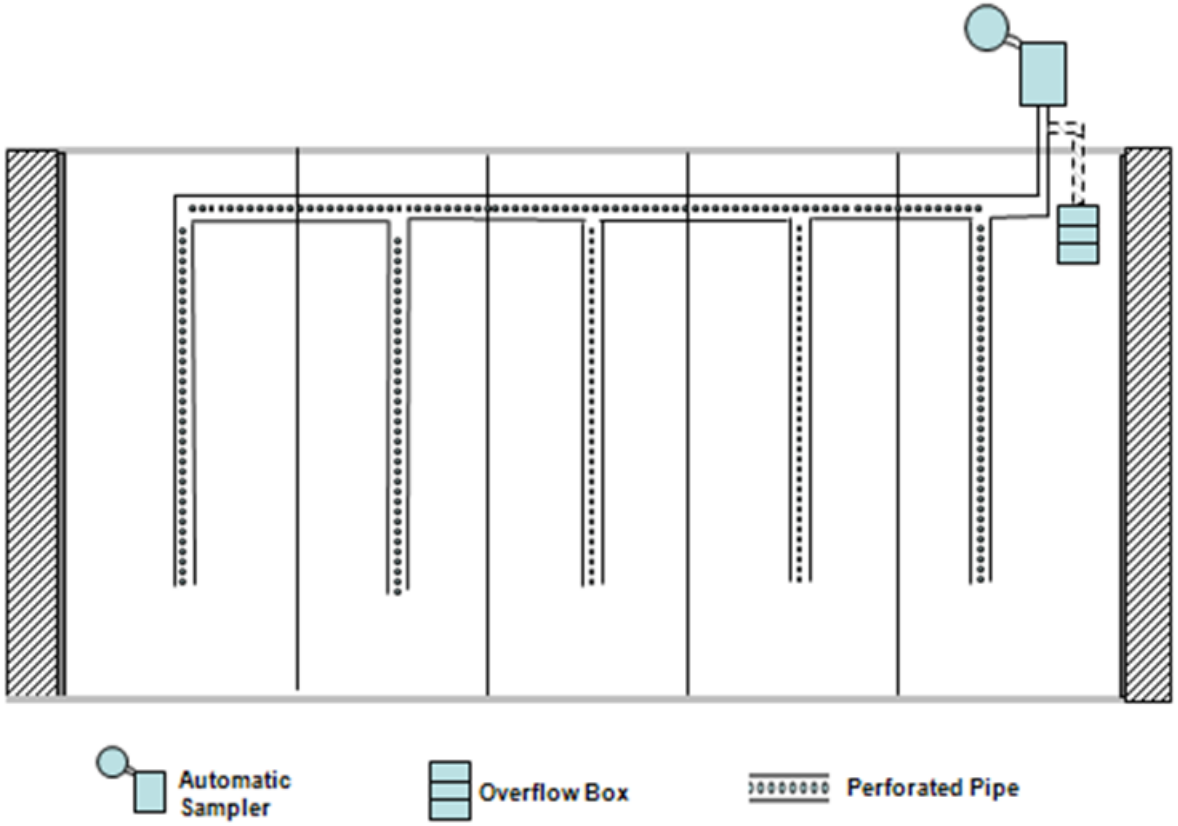
Turf Paver

Porous asphalt

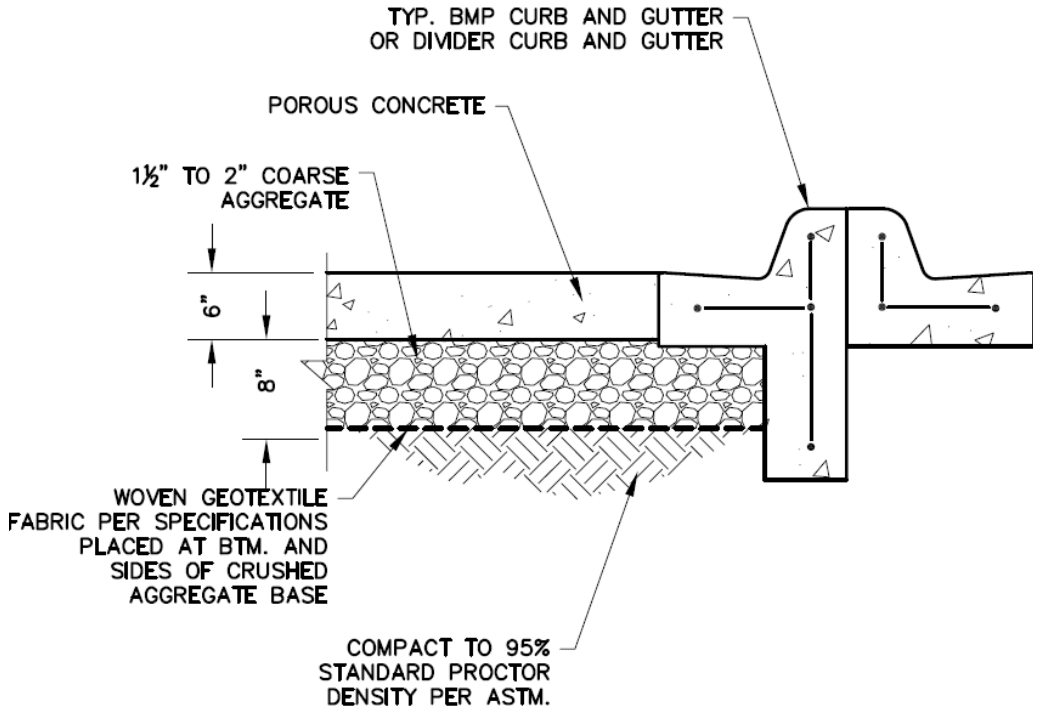
Porous concrete

Expanded shale mix

Layout and Drainage



Pervious Concrete Cross Section



POROUS CONCRETE 2

NOT TO SCALE

Green Roofs

Rainwater Harvesting as a Stormwater BMP

- Retains water on-site
- All water applied on high infiltration areas (yard)
- Reduces total volume and peak flow
- Conserves water

Bioretention Maintenance Task Schedule

Task	Frequency	Maintenance Notes
PRUNING	1 – 2 times/yr	Nutrients in runoff often cause bioretention vegetation to flourish
MOWING	2 – 12 times/yr	Frequency depends upon location and desired aesthetic appeal
MULCH REMOVAL	Once every 2 – 3yrs	Mulch accumulation reduces available water storage volume. Removal of mulch also increases infil. rate
WATERING	Once every 2 -3 days for first few months. Seldom after establishment	During droughts, watering after initial year may be needed
FERTILIZATION	Once initially	
REMOVE AND REPLACE DEAD PLANTS	Once per year	>10% of plants may die, survival rates increase over time
MISCELLANEOUS	Monthly	Trash collection, spot weeding, removing mulch from overflow

Permeable Pavement Maintenance Tasks and Schedule

TASK	SCHEDULE
Inspect Lot for Clogging	Semi-annual to Quarterly
Street sweeping and vacuuming	Per inspection results
Gravel replacement	Post-Vacuuming
Oil and grease cleaning	As needed per clientele
Avoidance of landscape debris (grass clippings, leaves)	Each landscape maintenance
Spray/$_{\text{Flame}}$ Weeds and Moss with Herbicides	Monthly during growing season
Adjoining land and watershed stabilization	Keep watch

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Associate Professor and Extension Specialist
Biological and Agricultural Engineering
Texas A&M AgriLife Extension
Dallas Research and Extension Center
f-jaber@tamu.edu
972-952-9672

www.facebook.com/agrilifeecoeng/

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MAINTENANCE PROGRAM STRATEGIES

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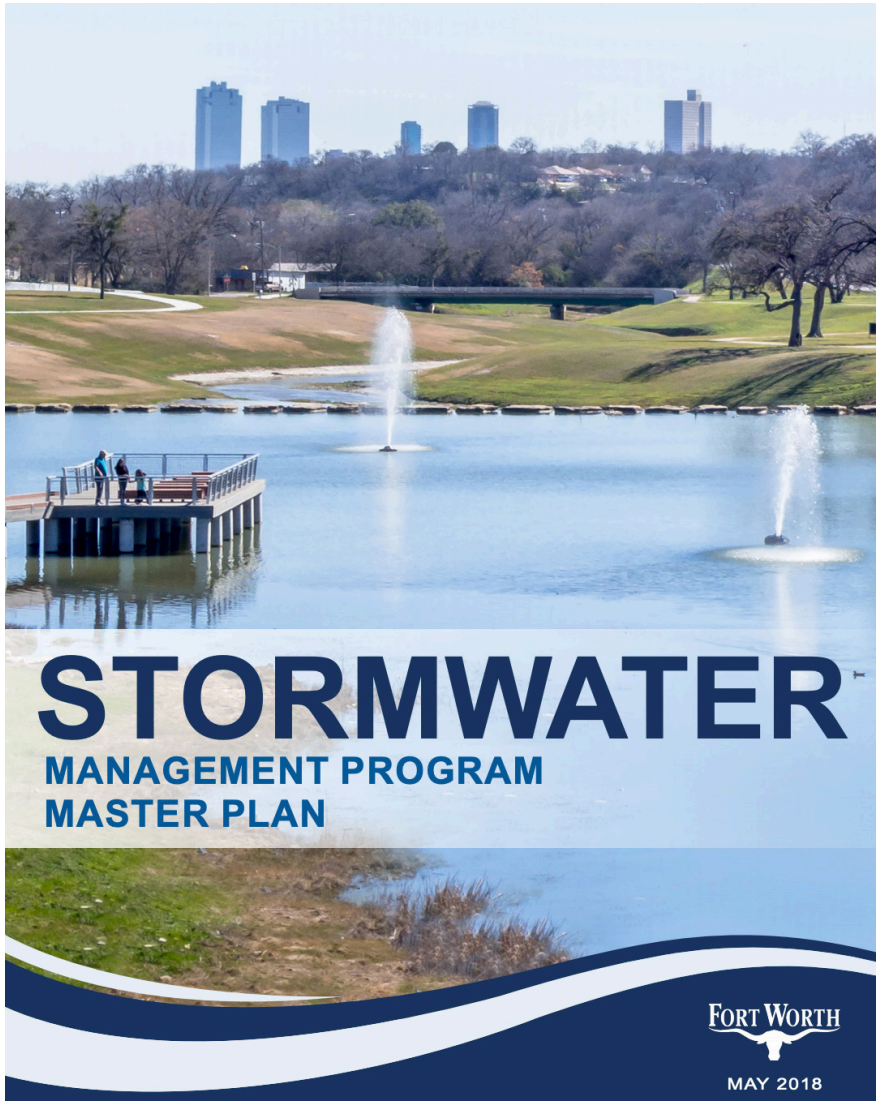
BEST PRACTICES AROUND REGION

BEST PRACTICES AROUND REGION

FORT WORTH

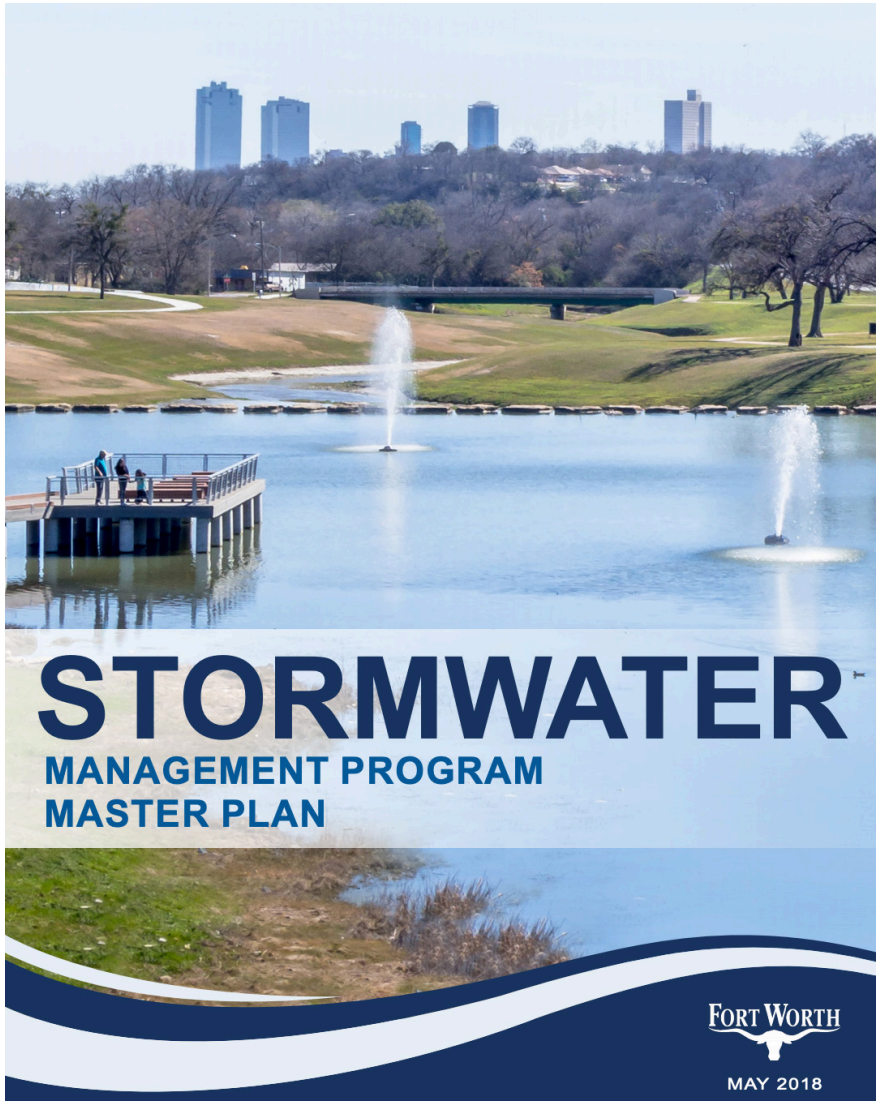
- Stormwater Program Master Plan
  - Specific Field Operations Section established to implement a prioritized, scheduled and proactive maintenance program
  - Development of a channel maintenance prioritization system
  - Vegetation maintenance program (3 times/year)
  - Inlet Cleaning Program



BEST PRACTICES AROUND REGION

FORT WORTH

- Stormwater Program Master Plan
  - 17 water quality devices
  - Pipe rehabilitation technology tested with pilot program
  - Dam inspections
  - Inventory and condition assessment
    - Storm drain inventory
    - Criticality assessment
    - Storm drain condition assessment
    - Channel inventory to identify and catalog assets



BEST PRACTICES AROUND REGION

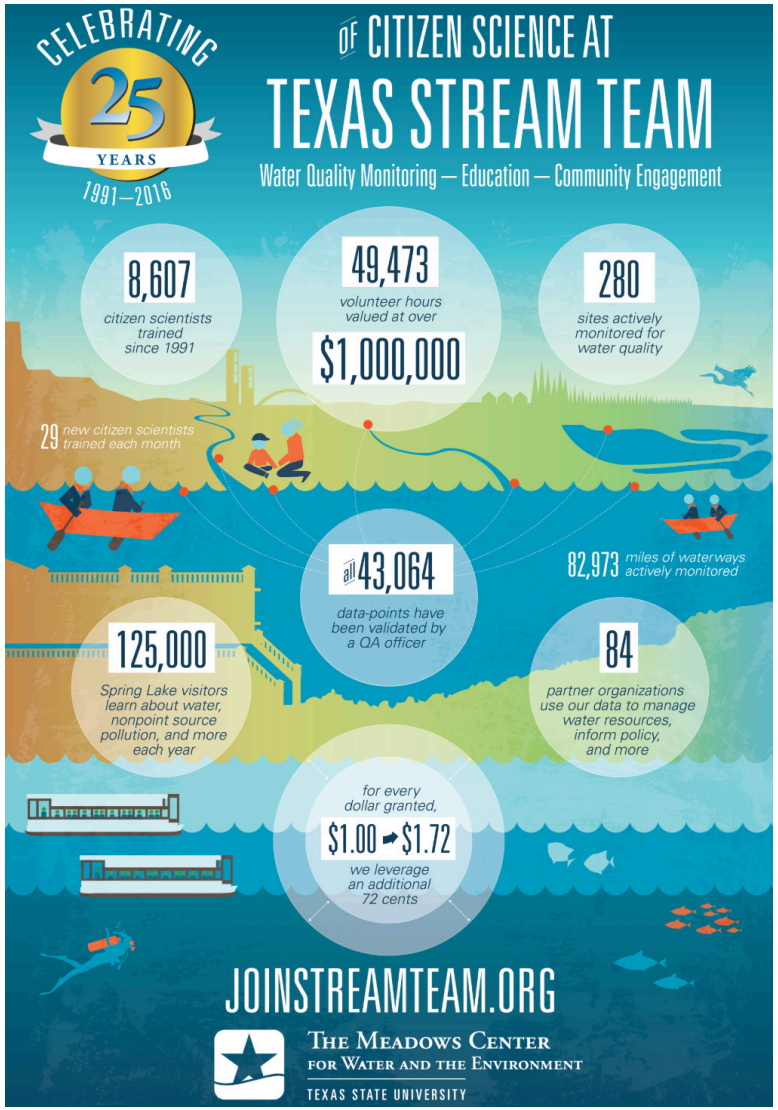
FRISCO

- Private BMP Inventory
  - Documented each BMP and tracking of maintenance and operation.
  - BMP owner education
- Public Works Facility
  - Staff managed and monitored BMPs on site
- Riparian corridor identification, prioritization for preservation/restoration

BEST PRACTICES AROUND REGION

AROUND THE REGION

- Texas Stream Team– Citizen Scientists
  - 8,607 trained since 1991
  - 49,473 volunteer hours
  - 280 sites actively monitored for water quality
  - 43,064 data points have been validated
  - 82,973 miles of water ways actively monitored
- Mansfield
  - Floatables management BMP implementation and tracking



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LIVE POLL – AUDIENCE PARTICIPATION:

1. TO JOIN THE SESSION, TEXTS HALFF TO 22333
2. FOR EACH QUESTION, TEXT LETTER OF YOUR CHOICE - A,B,C,D,E

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POLLING QUESTION #1

BEST PRACTICES

WHICH DO YOU FEEL IS MOST IMPORTANT FOR THE SUCCESS OF AN MS4 MAINTENANCE PROGRAM FOR POST CONSTRUCTION BMPS?

A. STAFF EDUCATION PROGRAMS
B. COMMUNITY OUTREACH AND EDUCATION
C. ROBUST ASSET INVENTORY MANAGEMENT
D. ACCESS TO MULTIPLE FUNDING SOURCES

Which do you feel is MOST important for the success of an MS4 maintenance program for post construction BMPs?

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DISCUSSION

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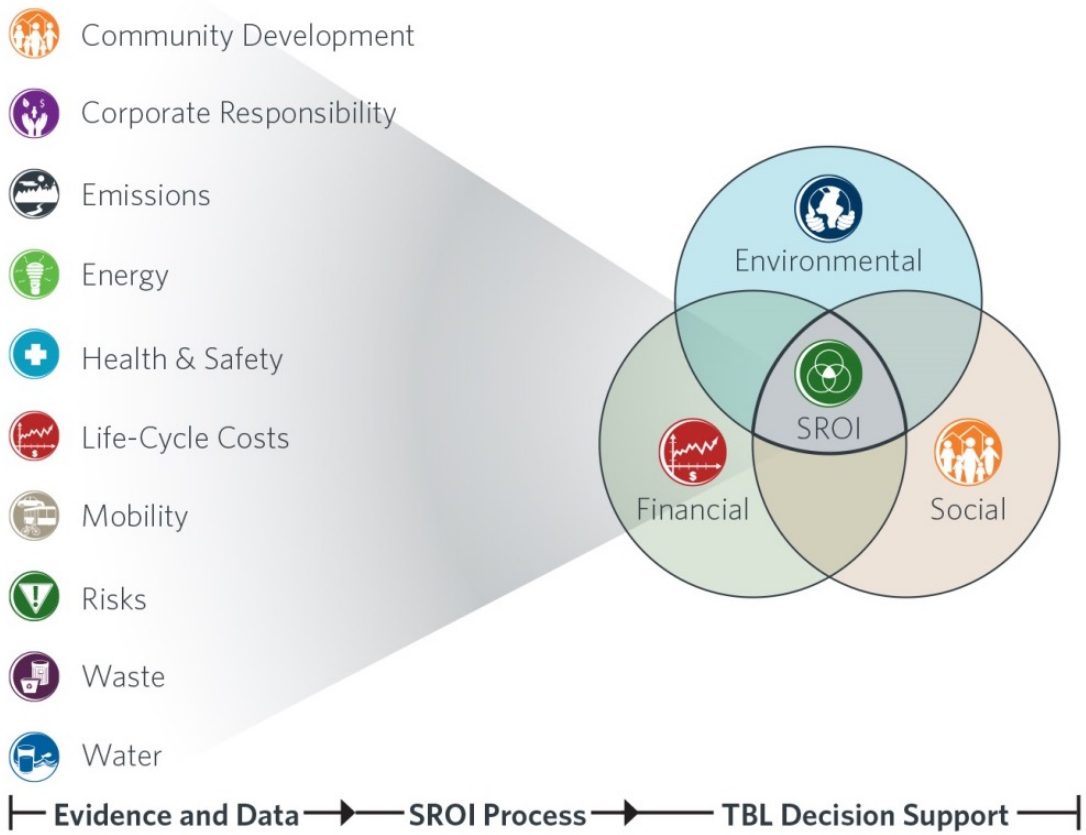
STRATEGIES AND RECOMMENDATIONS FOR BUDGETING

DISCUSS COMMUNICATION OF VALUES

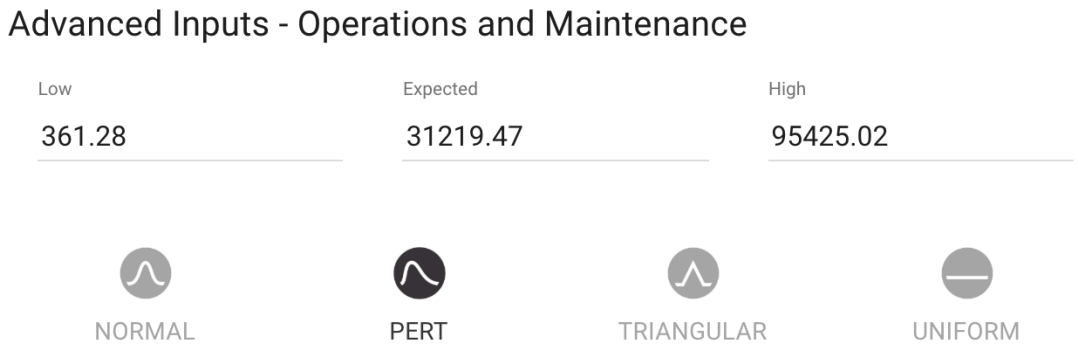
- Identification of Funding Gaps
  - Stormwater Charges and General Funds
  - Public Private Partnerships
- Consideration of Downstream Impacts
  - Erosion
  - Trash and Debris Management
  - Pollutant loading
  - Quality of Life
  - Market Value



STRATEGIES AND RECOMMENDATIONS FOR BUDGETING

PLANNING FORWARD

- Adding value to stormwater masterplans
  - Maintenance is a major cost consideration
  - Scale the post construction BMP implementation
  - Life cycle cost analysis is key
  - High cost or low cost? Find the balance.



STRATEGIES AND RECOMMENDATIONS FOR BUDGETING

PLANNING FORWARD

- Drill down on the O&M costs to find opportunities
  - Maintenance is a major cost consideration
  - Scale the post construction BMP implementation
  - Life cycle cost analysis is key
  - High cost or low cost? Find the balance.
  - Local mitigation concepts
  - Create the market

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POLLING QUESTION #2

BUDGETING

WHICH FUNDING SOURCE HAS THE MOST POTENTIAL FOR A COMMUNITY'S POST CONSTRUCTION STORMWATER MANAGEMENT PROGRAM?

A. GENERAL FUND
B. BOND ISSUANCE
C. STORMWATER UTILITY FEE
D. LEVERAGED PRIVATE CAPITAL – GREEN BONDS, WATERSHED IMPROVEMENT DISTRICTS, ETC

Which funding source has the most potential for a community's post construction stormwater management program?

General fund

Bond issuance

Stormwater utility fee

Leveraged private capital – green bonds, watershed improvement districts, etc.

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SUPPLEMENTAL GUIDANCE FOR MS4 REQUIREMENTS

UPDATES TO SMALL MS4 PERMIT

- Phase II MS4 Remand Rule
  - Effective January 9, 2017, and requires permit language that is “clear”, “specific”, and “measurable”
  - Adds public notice process for major modifications to SWMPs
- Asset management cycle
  - Typically requires a scheduled condition assessment

SUPPLEMENTAL GUIDANCE FOR MS4 REQUIREMENTS

UPDATES TO SMALL MS4 PERMIT

- Requirement that MS4s annually check, in conjunction with annual report, if a water body has been added to the impaired water bodies list
- Required to inspect and ensure operability and maintenance of post construction BMPs
- Level 4 MS4s need to develop a program to reduce the discharge of floatables in the MS4
- Level 4 MS4s need to evaluate their flood control projects to assess their impacts on receiving waters

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POLLING QUESTION #3

MS4 REQUIREMENTS

WHICH STATEMENTS ARE NOT SUPPORTED IN A SURVEY OF PHASE II COMMUNITIES?

A. 50% LACK A MAINTENANCE PROGRAM
B. 40% DO NOT KNOW WHERE BMPS ARE LOCATED
C. 58% LACK LEGALLY BINDING MAINTENANCE AGREEMENTS
D. MOST ARE DOING 'PRETTY GOOD'
E. 77% REPORT THEY INSPECT BMPS DURING CONSTRUCTION

*SOURCE SCHULER – CENTER FOR WATERSHED PROTECTION

Which statements are not supported in a survey of phase II communities?

50% lack a maintenance program

40% do not know where BMPs are located

58% lack legally binding maintenance agreements

Most are doing "pretty good"

77% report they inspect BMPs during construction

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DISCUSSION

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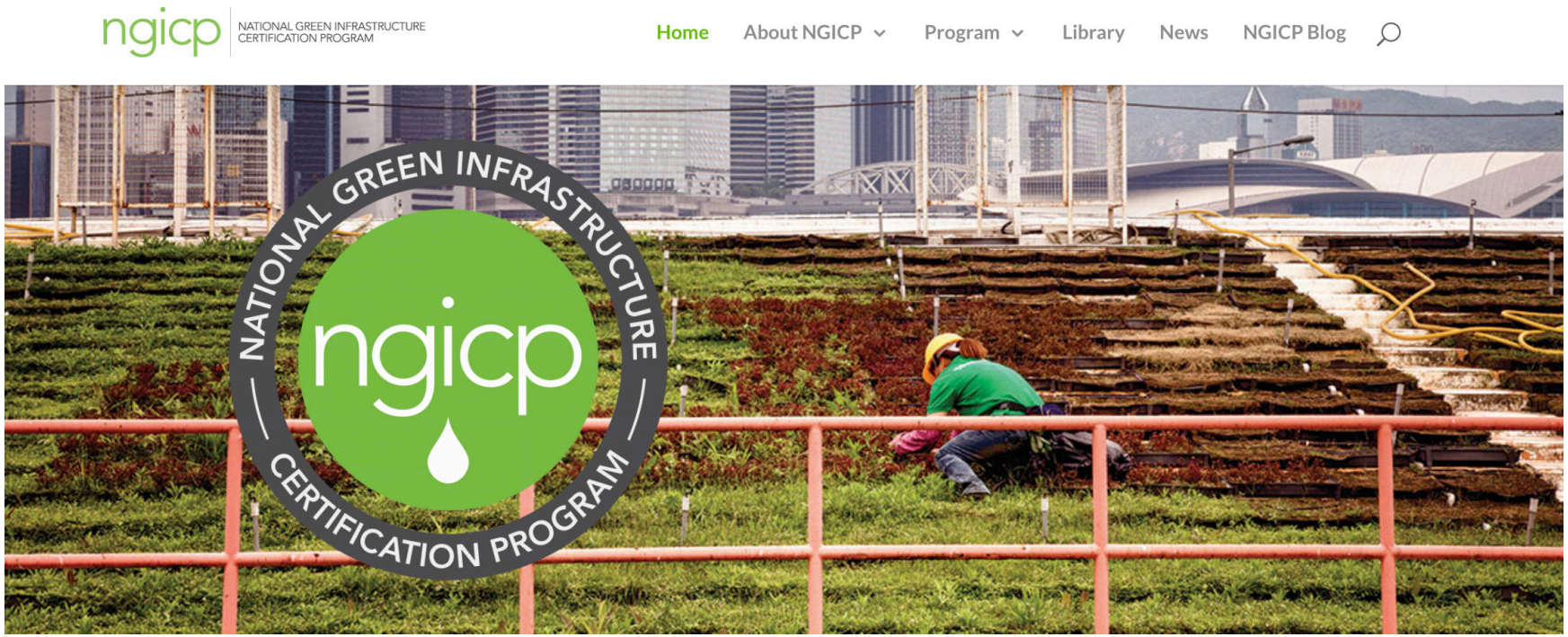
CASE STUDIES OUTSIDE THE REGION



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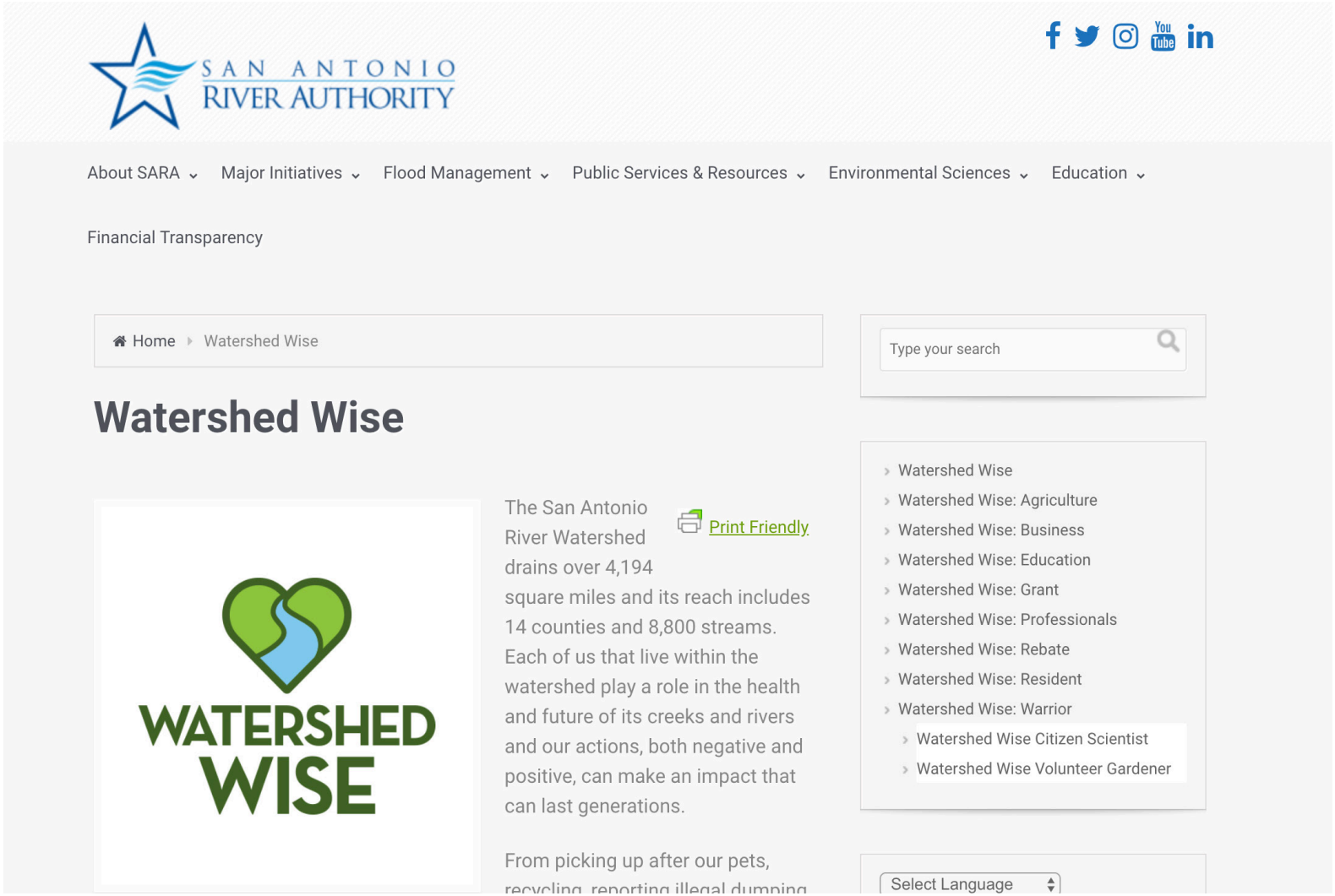
CASE STUDIES OUTSIDE THE REGION



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WATERSHED WISE

Print Friendly

The San Antonio River Watershed drains over 4,194 square miles and its reach includes 14 counties and 8,800 streams. Each of us that live within the watershed play a role in the health and future of its creeks and rivers and our actions, both negative and positive, can make an impact that can last generations.

From picking up after our pets, recycling, reporting illegal dumping

- Watershed Wise
- Watershed Wise: Agriculture
- Watershed Wise: Business
- Watershed Wise: Education
- Watershed Wise: Grant
- Watershed Wise: Professionals
- Watershed Wise: Rebate
- Watershed Wise: Resident
- Watershed Wise: Warrior
  - Watershed Wise Citizen Scientist
  - Watershed Wise Volunteer Gardener

Select Language

CASE STUDIES OUTSIDE THE REGION

NEW YORK
STATE OF
OPPORTUNITY.
Department of
Environmental
Conservation

MAINTENANCE GUIDANCE

Stormwater Management Practices

September 7, 2016

North Central Texas
Council of Governments

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CASE STUDIES OUTSIDE THE REGION

Table 5.6. Bioretention Example - Routine Maintenance Costs

Task	Frequency (x/year, Decimal)	Typical Extent	Extent	Hours (Unit)	Hours/yr	Level	Materials and Equipment	Annual Costs		
								Labor	Materials and Equipment	Total
Level 1 Inspection - 1 to 5-acre drainage	1	Practice	1	1 per inspection	1	1		$15		$15
Level 2 Inspection - 1 to 5-acre drainage	0.2	Practice	1	2 per inspection	0.4	2		$14		$14
Watering - grass and plants: Year 1	16	Weekly for first growing season, over filter surface area	1,000	0.5 per 400 sf area	24	1	Assume minimal cost for water	$360		$360
Trash and Debris Removal	4	Ponding area	1,500	1 per 400 sf practice surface area	15	1	Assume $25 Tipping Fee for Each Trip	$225	$100	$325
Weeding	2	Assume 50% of practice area	1,000	4 per 400 sf practice surface area	20	1		$300		$300
Mulching	1	Ponding area	1,500	4 per 400 sf area	15	1	Bark mulch; assume 15 cy/application	$225	$150	$375
Sediment Removal (minor)	1	Assume one small area per inlet	1	1 per small area	1	1		$15		$15
Erosion Repair (minor)	1	Inlets; assume 25 sf/practice	25	1 per 25 sf	1	1	Seed, mulch and topsoil	$15	$10	$25
Erosion Repair (minor)	1	10% of slope area	50	1 per 25 sf	2	1	Seed, mulch and topsoil	$30	$20	$40
Minor Regrading	0.5	1 spot per 400 sf of practice area	5	1 per repair	2.5	2	Assume done by hand	$88		$88
Planting (plants)	0.2	Assume 50% of practice area	1,000	8 per200 sf	8	1	Assume 500 plants/planting	$120	$100	$220
Minor PVC or Metal Repairs (observation well cap, PVC riser, grates)	0.2	1 per practice	1	1 per repair	0.2	2	Assume about a $100 piece of equipment	$7	$20	$27
Sediment Removal (small forebay)	0.2	per forebay	1	2 per forebay	0.4	2	Assume removal by hand	$14		$14
							Total Costs - Year 1	**$1,428**	**$400**	**$1,828**
							Total Costs - Subsequent Years	**$1,068**	**$400**	**$1,468**

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DISCUSSION

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Water Quality BMP Maintenance Implementation

Presenters: Anthony Kendrick & Dan Conaway

BIORETENTION & VEGETATED SYSTEMS

Design: Plant Selection

Design: Plant Selection

Design: Plant Selection

Design: Mulch

Design: Mulch

Design: Mulch Should Clog

Design: Engineered Soil

<u>Cameillia – Bioretention Basin</u>

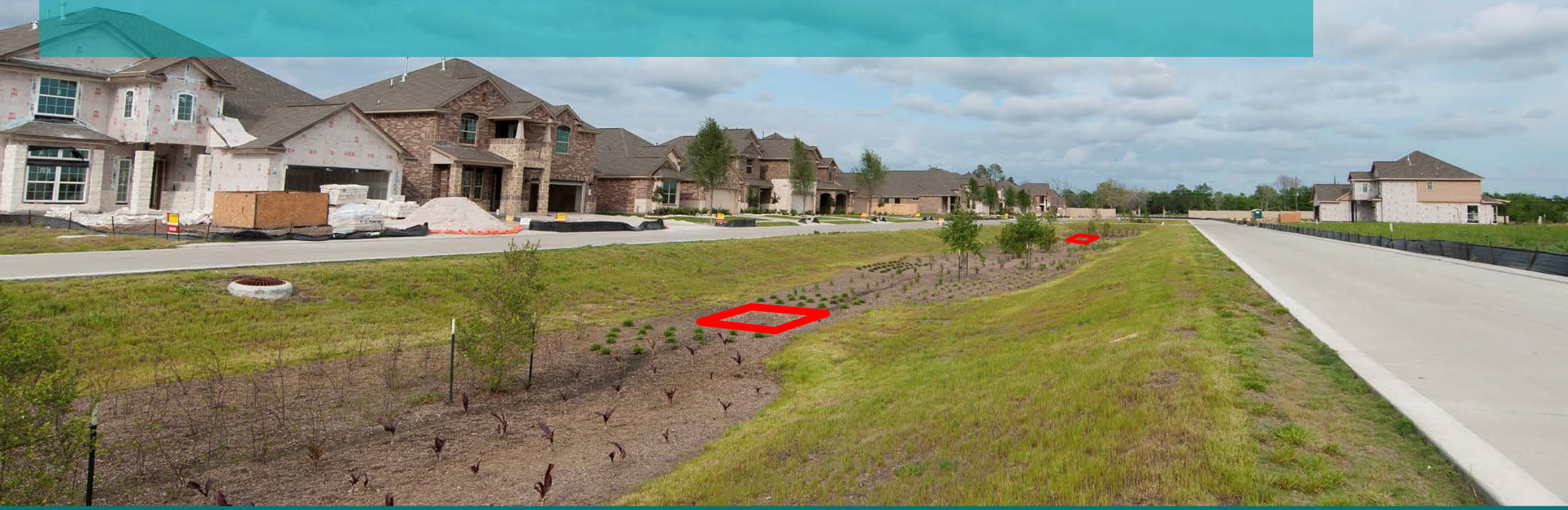
Drainage Area – 143,715 SF (3.29 Acres)

Water Stored – 85,813 CF (642,000 Gallons)

Water Treated – 78,400 CF (586,432 CF)

High Flow Media – 196 SF → $29,400

Low Flow Media – 7,840 SF → $156,800



Design: High Flow Media

Design: Low Flow Media vs High Flow Media

Design: Low Flow Media vs High Flow Media

$$A_f = \frac{(WQ_v)(d_f)}{[(k)(h_f + d_f)(t_f)]} = \frac{(20,909)(3)}{[(0.5)(0.25 + 3)(2)} = 19,300\ square\ feet$$

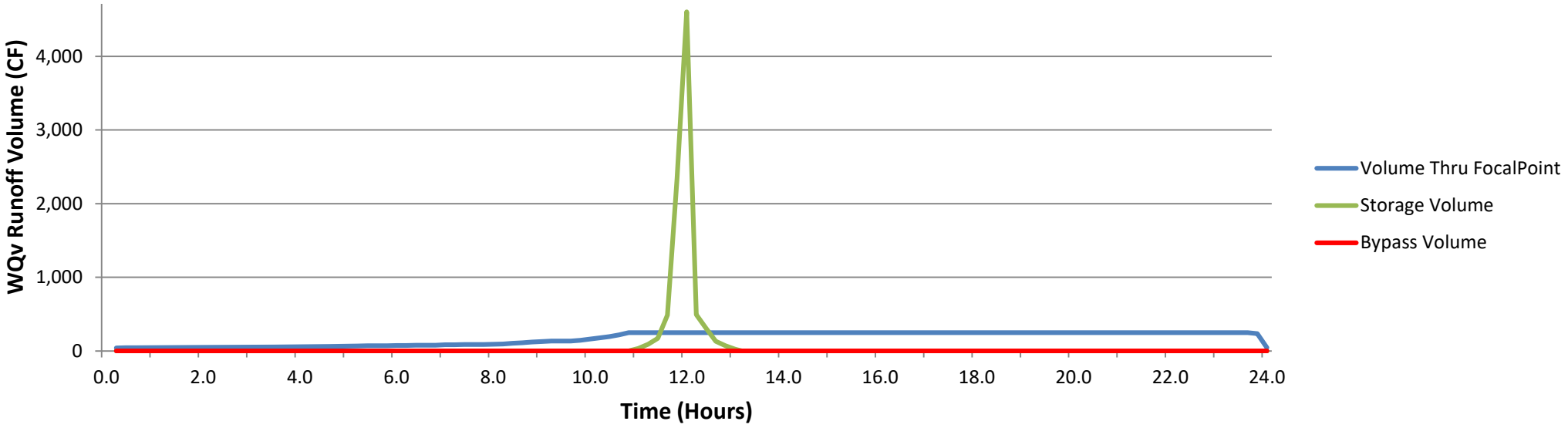
Low Flow Media Sizing Method

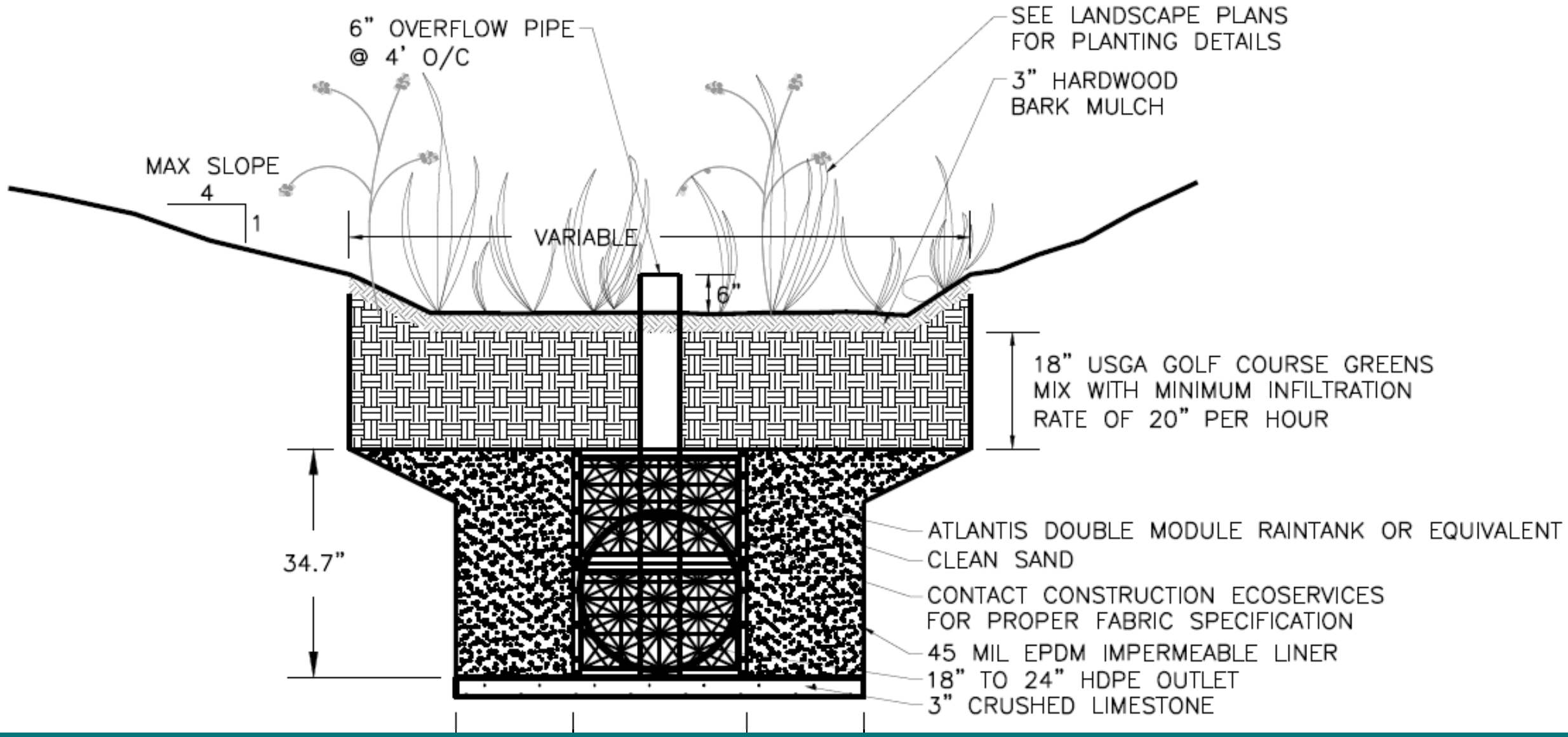
- 5 acre lot with 80% impervious cover.
- Filter bed depth = 3 feet
- WQv = 20,909 CF
- Surface Storage = 9,650 CF
- *Safety Factor of 2*
- Engineered Soil Flow Rate = *0.5 inches/hr*
- Filtration Bed Footprint = **17,922 SF**
- Construction Costs @ 10$/SF = **$179,220**

High Flow Media Sizing Method

- 5 acre lot with 80% impervious cover.
- Filter bed depth = 2 feet
- WQv = 20,909 CF
- Surface Storage = 9,650 CF
- *Safety Factor of 2*
- *1 day* filter bed drain time

- Engineered Soil Flow Rate = *100 inches/hr*
- Filtration Bed Footprint = **300 SF**
- Construction Costs @ 175$/SF= $52,500





Design: Sub-Surface Storage / Infiltration / Conveyance

Design: Sub-Surface Storage / Infiltration / Conveyance

Design: Sub-Surface Storage / Infiltration / Conveyance

Design: Sub-Surface Storage / Infiltration / Conveyance

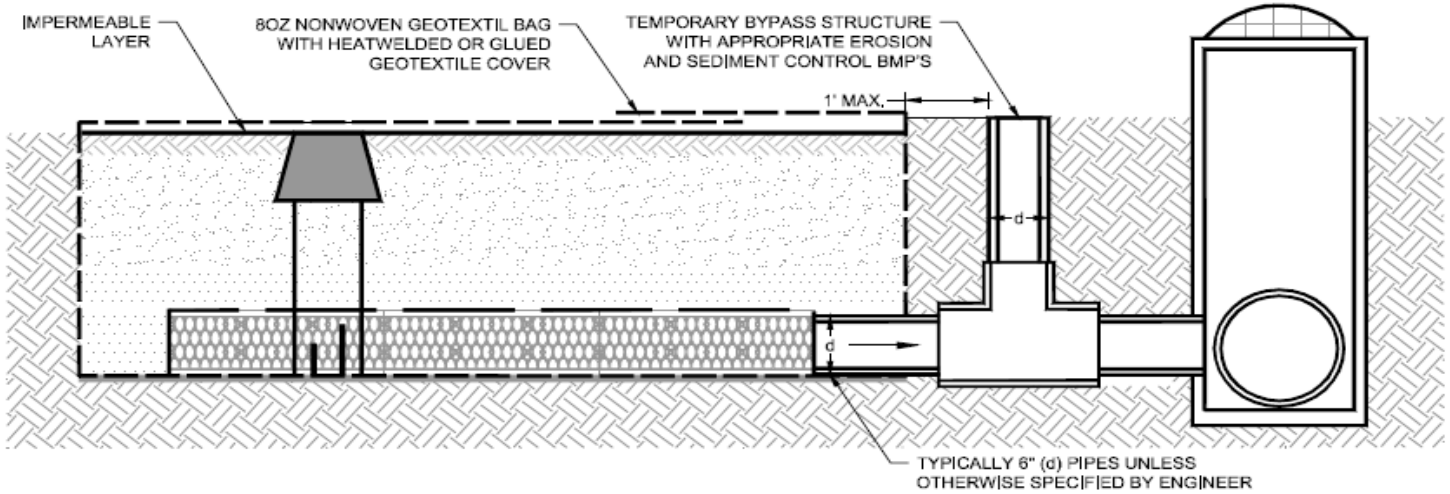
Design: Sub-Surface Storage / Infiltration / Conveyance



Design: Bridging Stone

Construction: Sediment Protection

Construction: Sediment Protection



NOTE: IN ORDER TO PROTECT THE FOCALPOINT BIOFILTRATION SYSTEM FROM INUNDATION OF SEDIMENT DURING CONSTRUCTION ACTIVITIES, USE AN 8OZ NON-WOVEN GEOTEXTILE CAP WITH IMPERMEABLE LINER TO PROTECT THE SYSTEM. IN ORDER TO DO THIS, LAY IMPERMEABLE LINER OVER MULCH BED. THEN OVERLAP THE GEOTEXTILE AND EITHER USE A GEOTEXTILE ADHESSIVE OR A TORCH TO WELD THE FABRIC TOGETHER CREATING A SEAL. THIS PROTECTIVE BARRIER MUST NOT BE REMOVED UNTIL THE SITE IS 70% STABILIZED AND THE SWALE DRAINING INTO THE FOCALPOINT IS AT LEAST 90% STABILIZED. ONCE THE SITE IS STABILIZED, CONTACT YOUR CONVERGENT VALUE ADDED RESELLER SALES REPRESENTATIVE TO HAVE THE SYSTEM ACTIVATED. ONCE ACTIVATED, TEMPORARY BYPASS STRUCTURE IS TO BE PERMANENTLY CAPPED OR REMOVED.
DO NOT ACTIVATE THE SYSTEM WITHOUT A REPRESENTATIVE THERE TO INSPECT THE SITE OR THE WARRANTY WILL BE VOID.

FOCALPOINT PROTECTION PROCEEDURES

FocalPoint BIOFILTRATION SYSTEMS

TO FIND A VALUE ADDED RESELLER IN YOUR AREA VISIT
WWW.CONVERGENTWATER.COM/STORMWATER-PRODUCTS OR CONTACT
CONVERGENT WATER TECHNOLOGIES AT 800.771.5428

CONSTRUCTION ECO SERVICES

Construction: Sediment Protection

Construction: Quality Assurance

Construction: Performance Verification

Maintenance: Clogged Overflows

Maintenance: Erosion

Maintenance: Erosion

Maintenance: Erosion & Sedimentation

Maintenance: Forebays & Inlet Structures

Maintenance: Forebays & Inlet Structures

Maintenance: Forebays & Inlet Structures

Detention Ponds
Maintenance

Mitigate increased runoff volumes from urbanization and act as treatment basin for pollutant removal if properly maintained

Poorly maintained ponds increase pollutant discharge, flood risk downstream, instability of downstream channels, aesthetic/nuisance problems

Maintenance Considerations

- **Routine**
  - Inspections
  - Vegetation management: maintain 4-6” deck height
  - Trash & debris removal
  - Mechanical equipment check
  - Structural component check

- **Non-Routine**
  - Bank erosion/stabilization
  - Sediment Removal
  - Structural repair/replacement of outlet, trickle channel, trash rack, etc.

Inspection Checklist

Obstructions to the inlet/outfall?

Trash in the pond or on the rack?

Erosion apparent on slopes?

Sedimentation in the basin?

Settling or cracking on berms?

Changes in upstream/downstream conditions?

Conveyance in good working order?

Case Study
The Parking Spot

Background

- **Airport parking facility received NOV from City of Austin**
- **Sedimentation/sand filtration pond**
- **Sedimentation and scouring, excessive vegetation (including woody plants), gaps in expansion joints, erosion rilling at outfall**
- **Pond exceeded 48-hour drawdown**

Solution

- **Sediment and vegetation removed from splitter box and sedimentation basin**
- **Cracks and gaps filled with expansion joint filler**
- **Regrading of sedimentation basin, restoring design elevation and positive drainage**

Takeaway…

- Regular maintenance could have prevented costly repairs
- Since rehab, pond has been inspected quarterly, mowed monthly, and sediment removed as necessary
- Maintenance approach has not only ensured COA compliance, but has provided owner with peace of mind

CONSTRUCTION ECO SERVICES

Permeable Pavements

Permeable Pavements

↓

Inlets

High Flow Rate & High Performance

↓

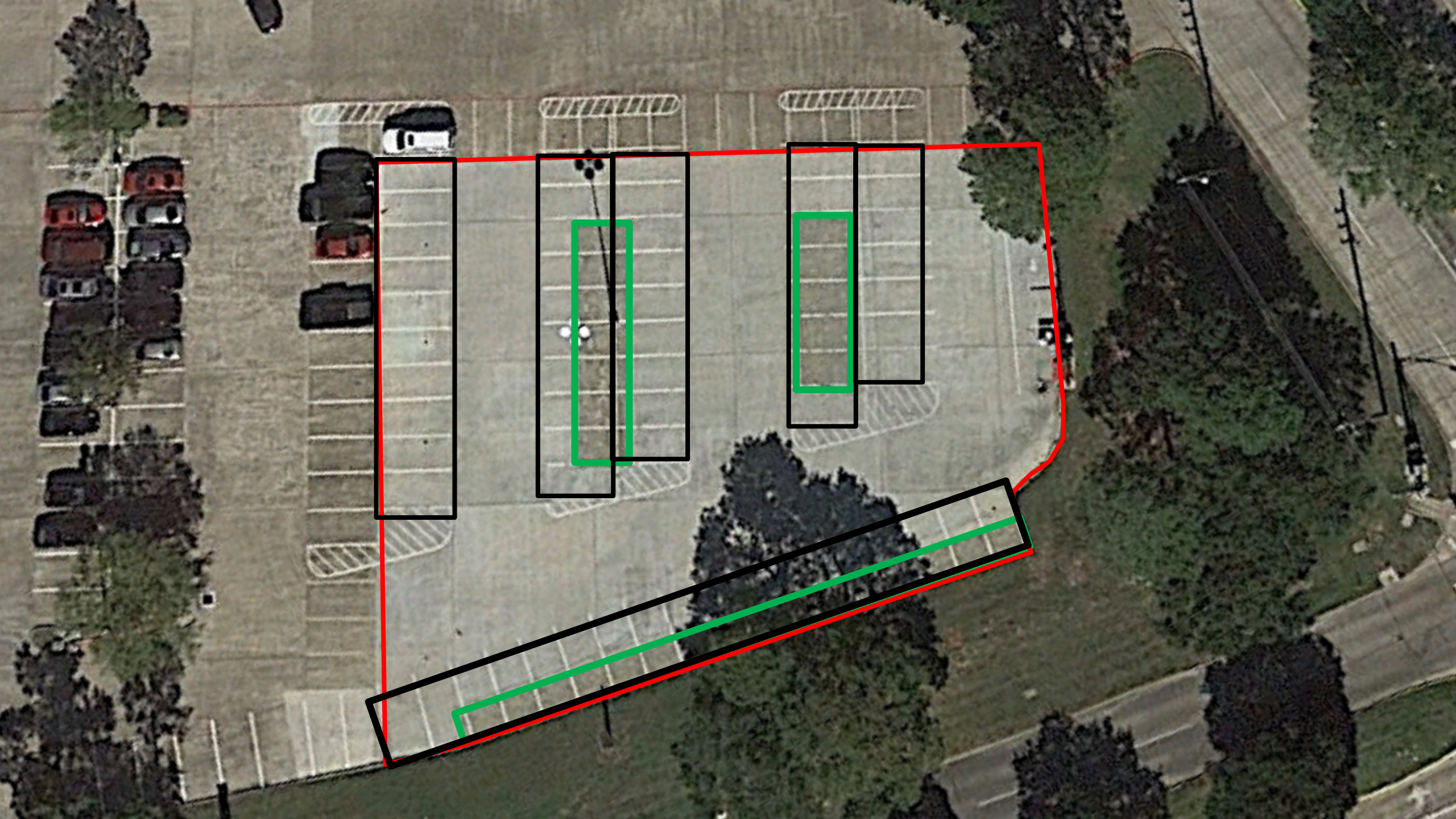
Lower Maintenance

Open Jointed Pavers

- 1,500 IN/HR Infiltration Rate
- 10:1 Drainage Ratio

Interlocking Pavers

- 400 IN/HR
- 3:1 Drainage Ratio



Average Infiltration Rate (in/hr)	
Pervious Concrete =	1,367
PaveDrain =	1,429
PaveStone Eco-Priora =	549

Infiltration Rate (in/hr) after 6 months	
Pervious Concrete =	1,070
PaveDrain =	820
PaveStone Eco-Priora =	309*

*1st location failed due to clogging

Design: Traffic Loading

Design: Traffic Loading

Design: Performance

Maintenance: Accessibility

Maintenance: Accessibility

Construction: Sediment Protection

Figure 21. A regenerative air machine cleaning a PICP parking lot.

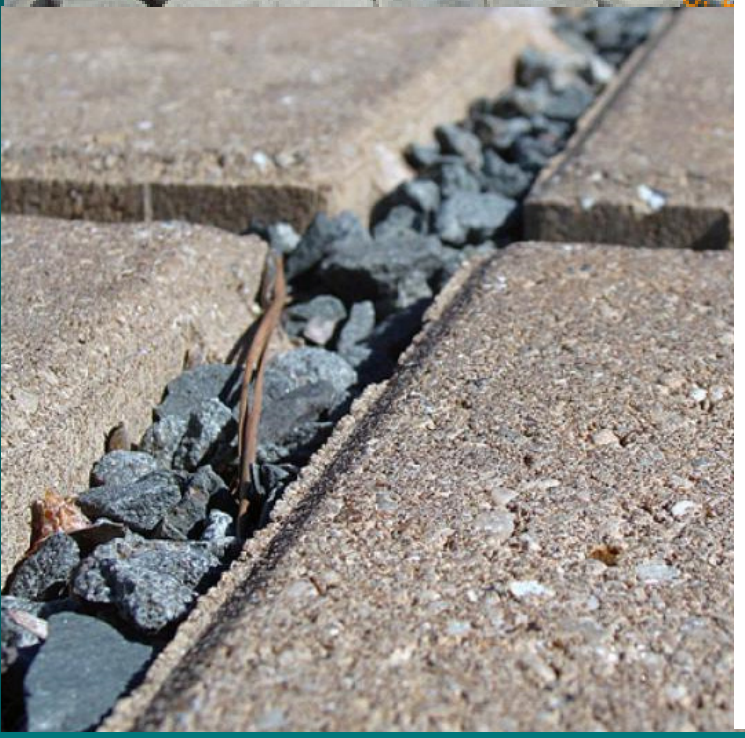
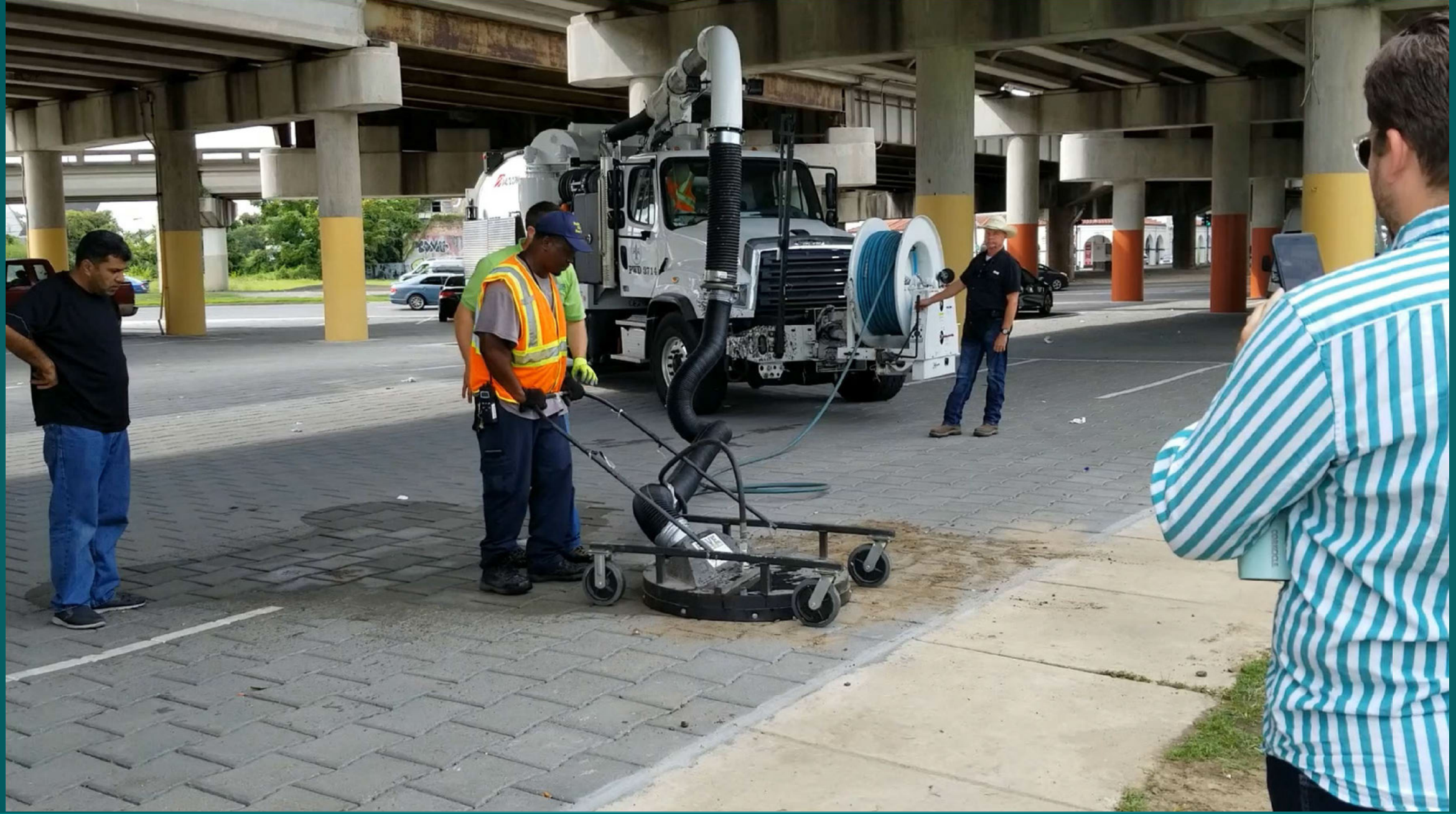


Figure 22. A true vacuum machine cleaning neglected PICP.

Maintenance: Vacuum Truck Attachments



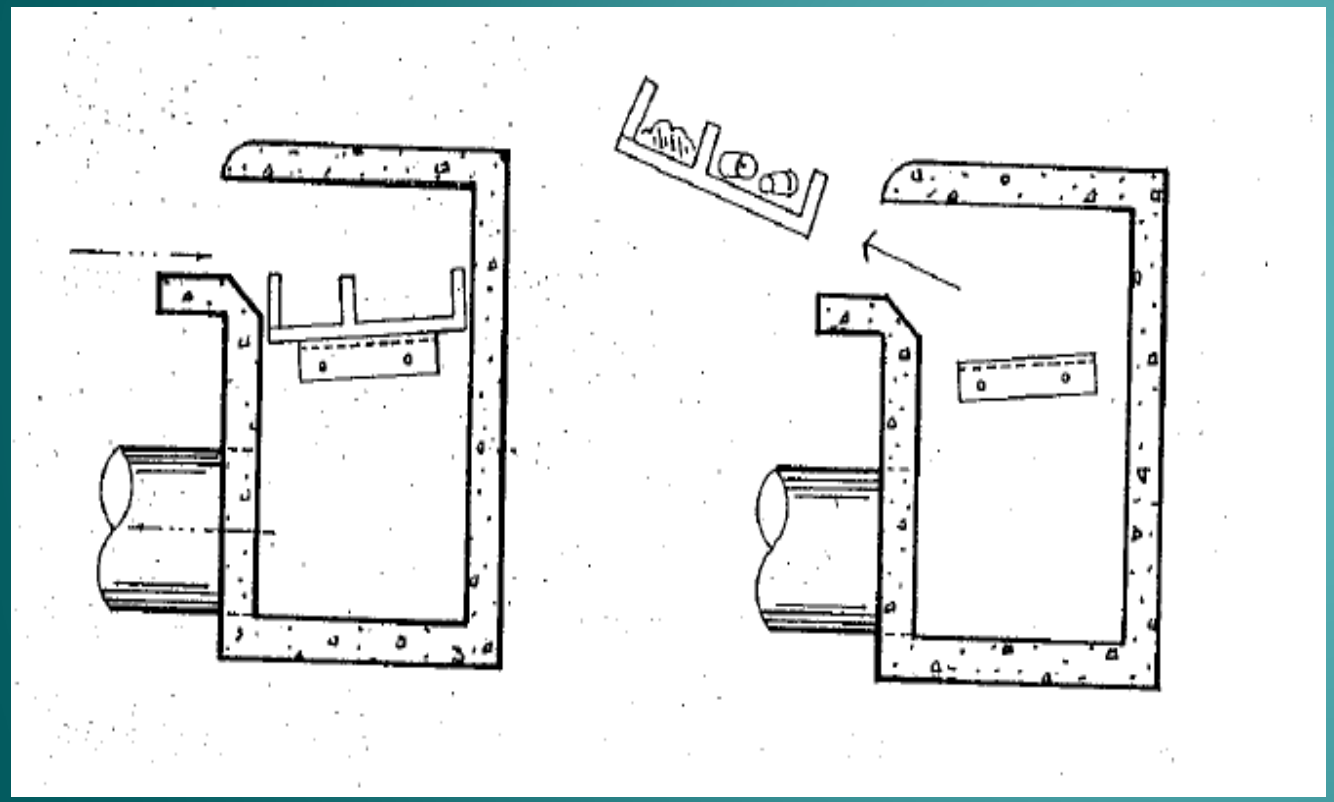
Maintenance: Vacuum Truck Attachments

Structural Stormwater Quality Units

Maintenance

Maintenance: Inlet Treatment

- “**Traps**” installed in early ‘90s
- 16 routes/170 inlets proposed
- 3 routes/~80 inlets remain



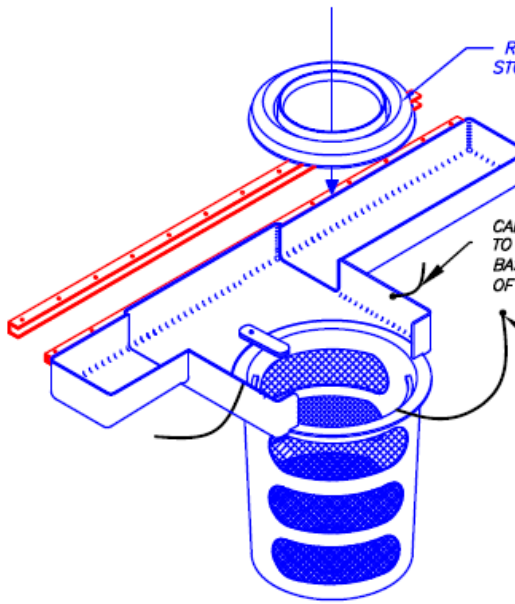
Maintenance: 6th Street – Austin, TX

Maintenance: 6th Street – Austin, TX

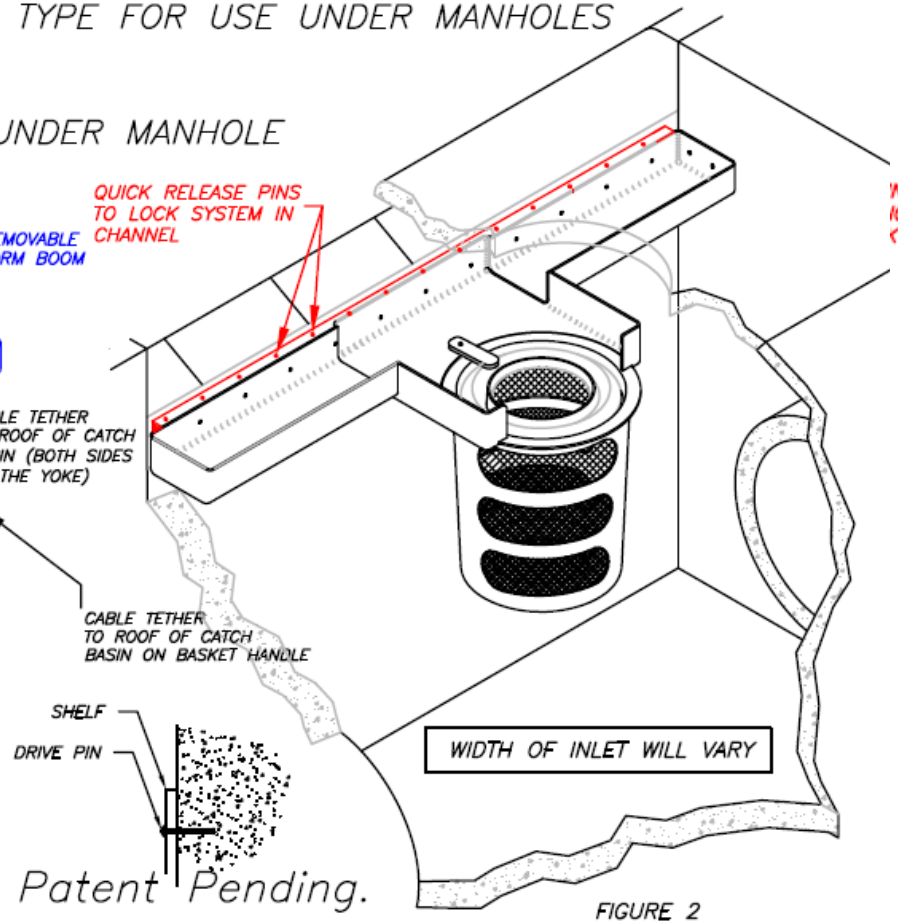
Maintenance: 6th Street

HIGH CAPACITY CURB INLET BASKET SYSTEM
QUICK RELEASE TYPE FOR USE UNDER MANHOLES

ROUND GISB FOR MOUNTING UNDER MANHOLE



DETAIL OF PARTS
FIGURE 1



Patent Pending.

FIGURE 2
DETAIL OF INSTALLATION

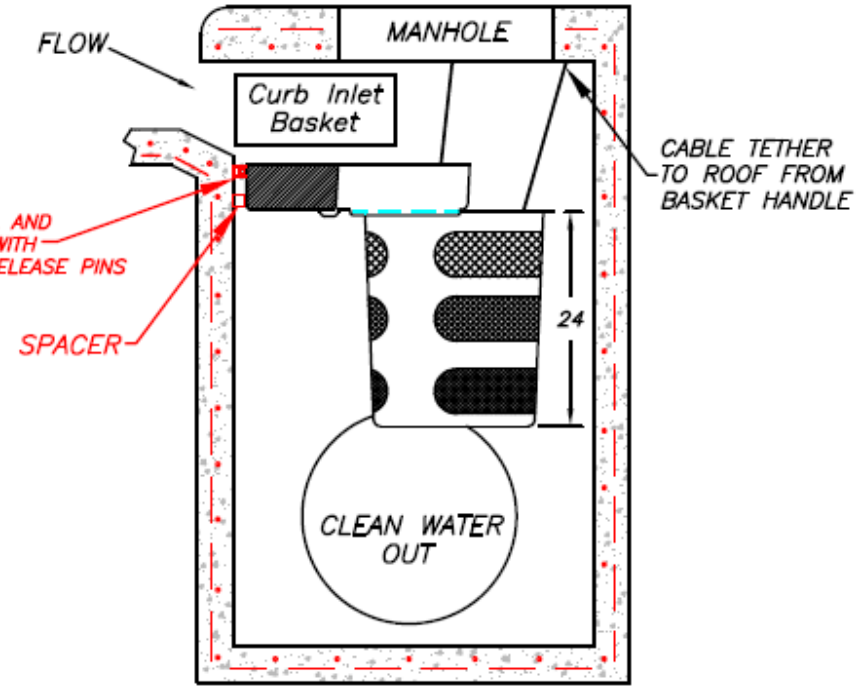


FIGURE 3
DETAIL OF PROCESS

REMOVABLE BASKET CATCHES EVERYTHING AND MAY BE REMOVED THROUGH MANHOLE WITHOUT ENTRY.

Maintenance: 6th Street – Austin, TX

6th Street Maintenance Study	17 Traps	17 Baskets
# minutes per route	30	272
# visits per year	52	12
# of crew per visit	4	2
Man-hours per year	104	109
labor cost/ yr @ $19.28/hr	$2,005	$2,098
lbs collected per year	1,326	4,284
$/lb collected	$1.51	$0.49

Maintenance: Greenville Ave

Maintenance: Greenville Ave

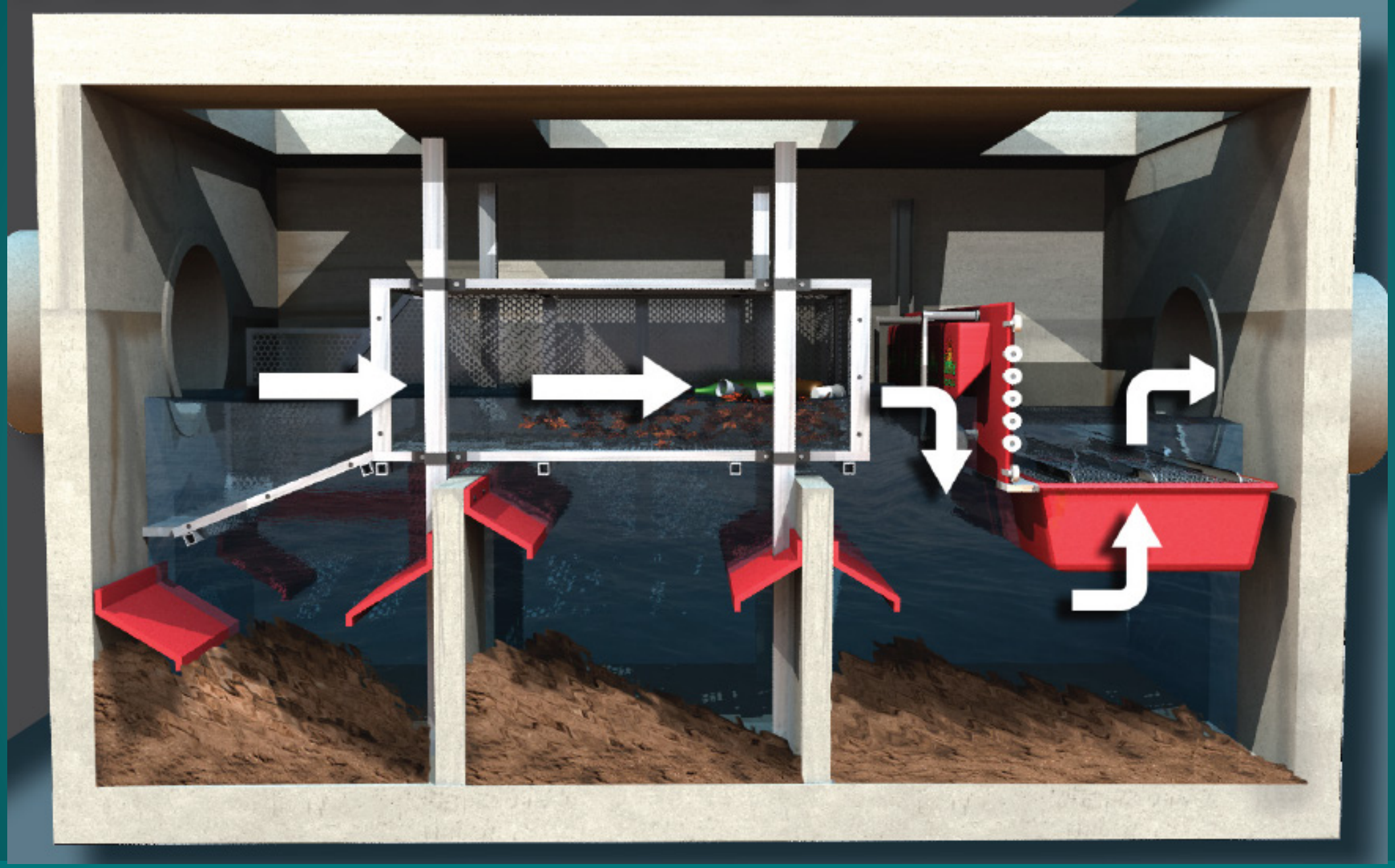
Maintenance: End-of Pipe Systems

Maintenance: End-of Pipe Systems

Maintenance: End-of Pipe Systems

Maintenance: Accessibility

Maintenance: Accessibility



Maintenance: Elevated Trash Rack

Maintenance: Elevated Trash Rack

Maintenance: Elevated Trash Rack

Case Studies

North Texas

Merritt Road
Rowlett, TX

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Maintenance: Erosion & Plants

Medical Center
Fort Worth, TX

Maintenance: Erosion Issues

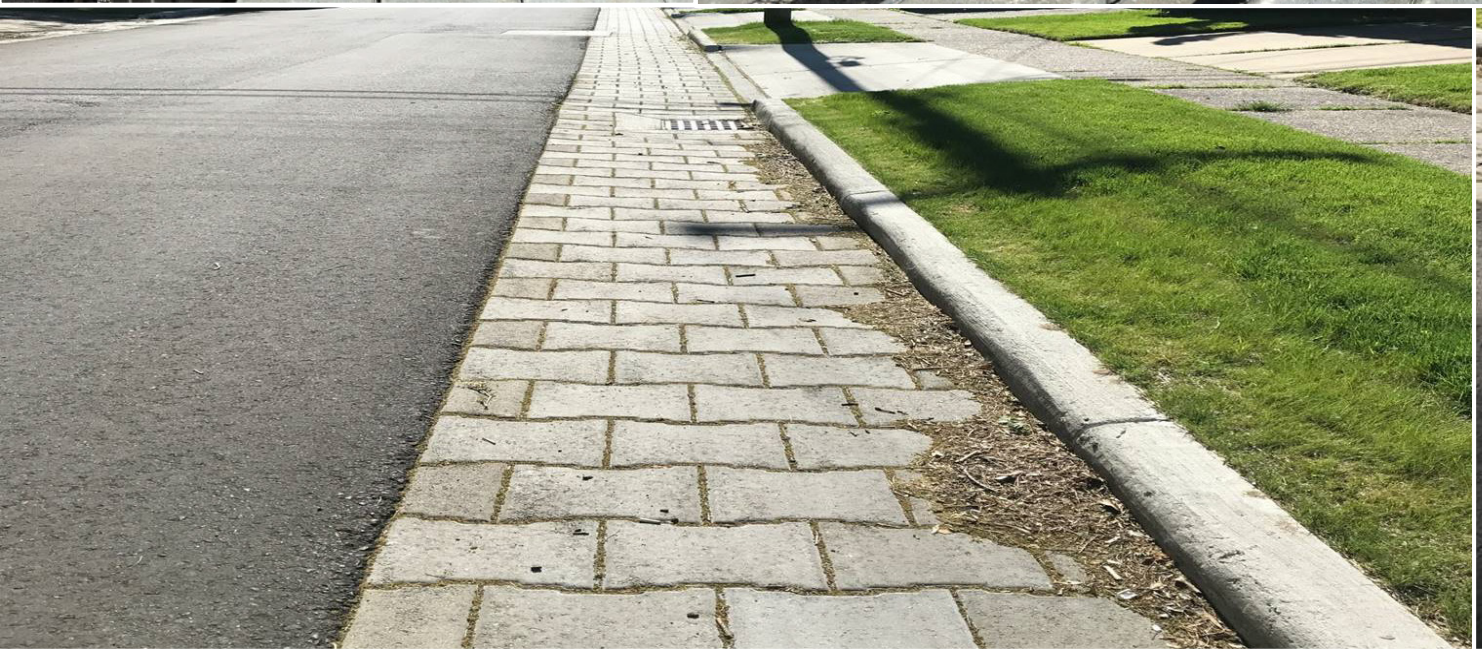
Maintenance: Plants & Mulch

Maintenance: Making it Simple

Maintenance: Performance

Maintenance: Damaging Grey Infrstructure

Keeler Street
Michigan



Maintenance: Keeler Street Maintenance Study (Tetra Tech)

Table 2 Test Results

Location	Method	Infiltration Before Cleaning (inch/hr.)	Infiltration After Cleaning (inch/hr.)	Observations
Keeler No. 1	ASTM	217	1,609	At the start of testing as water was poured on the PaveDrain, it was observed that water washed areas of the built up debris out of the voids between the blocks.
	NCSU SIT	59	753	
Keeler No. 2	ASTM	49	816	Prior to cleaning the testing area was filled with debris and leaves in the gutter line.
	NCSU SIT	32	233	
Artesian No. 1	ASTM	21	320	Prior to cleaning looked visibly dirty along the road
	NCSU SIT	24	154	

Maintenance: Keeler Street Maintenance Study (Tetra Tech)

Car Dealership

Frisco, TX

Construction: Erosion & Sedimentation

Construction: Erosion & Sedimentation

Construction: Erosion & Sedimentation

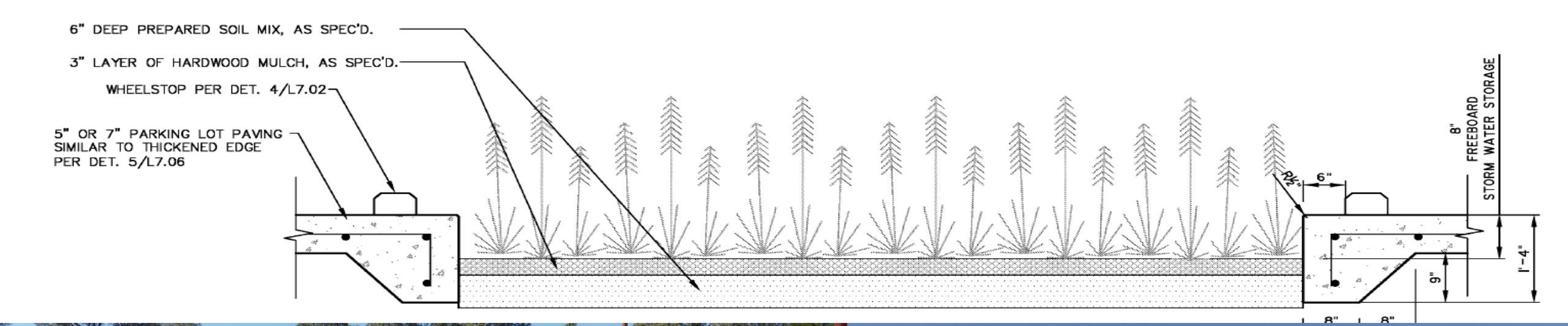
Construction: Erosion & Sedimentation

Construction: Erosion & Sedimentation

Construction: Erosion & Sedimentation

DoubleTree Ranch & Park

Highland Village, TX


6" DEEP PREPARED SOIL MIX, AS SPEC'D.
3" LAYER OF HARDWOOD MULCH, AS SPEC'D.
WHEELSTOP PER DET. 4/L7.02
5" OR 7" PARKING LOT PAVING SIMILAR TO THICKENED EDGE PER DET. 5/L7.06
8" FREEBOARD STORM WATER STORAGE
6"
9"
1'-4"
8"
8"

Construction: Plan Review

Construction: Plan Review

Construction: Plan Review

Construction: Plan Review

Construction: Plan Review

Money Gram Park

Dallas, TX

Maintenance: Clogged Bioretention Cells

Maintenance: Clogged Bioretention Cells

Maintenance: Clogged Bioretention Cells

Maintenance: Clogged Bioretention Cells

Maintenance: Making it Simple

TCU Parking Lot
Fort Worth, TX

Construction: Aggregate Sub-base

Construction: Aggregate Sub-base

Construction: Aggregate Sub-base

Construction: Aggregate Sub-base

Construction: Aggregate Sub-base

North Service Center

Fort Worth, TX

Vegetation Establishment: Bioswales

Vegetation Establishment: Bioswales

Vegetation Establishment: Bioswales

Vegetation Establishment: Bioswales

Vegetation Establishment: Bioswales

Vegetation Establishment: Bioswales

QUESTIONS?

Anthony Kendrick, ENV SP
(214) 701-2117
kendrick@ecosvs.com

Dan Conaway
(512) 417-4586
Conaway@ecosvs.com

Construction EcoServices
Houston | Dallas-Fort Worth | Austin | San Antonio | New Orleans
832.456.1000
www.ecosvs.com

ISWM WORKSHOP

STORMWATER BMP MAINTENANCE

DECEMBER 4, 2018

North Central Texas
Council of Governments

STORMWATER BMP MAINTENANCE WORKSHOP - AGENDA (12/4/18)

1. **Welcome and Introductions**
2. **Overview of Water Quality BMPs and Maintenance** (30 mins) – Dr. Fouad Jaber, Texas A&M AgriLife
3. **Maintenance Program Strategies** (45 mins) - Mikel Wilkins, Urban Ecoplan
    a. Best practices around region
    b. Strategies and recommendations for budgeting
    c. Supplemental guidance for MS4 requirements
    d. Case studies outside the region
4. **Water Quality BMP Maintenance Implementation** (90 mins) – Anthony Kendrick and Dan Conaway, Construction Ecoservices
    a. Vegetated systems
    b. Permeable pavements
    c. Structural stormwater quality units
    d. Life cycle costs
    e. Design considerations to reduce maintenance
    f. Case studies
5. **Maintenance Data Collection and Management** (30 mins) – Matt Stahl and Ben Pylant, Halff Associates
    a. Mobile Data Collection
    b. Asset management / work order strategies
6. **Closing Remarks and Evaluations**

ISWM WORKSHOP: STORMWATER BMP MAINTENANCE

MAINTENANCE DATA COLLECTION AND MANAGEMENT

DECEMBER 4, 2018

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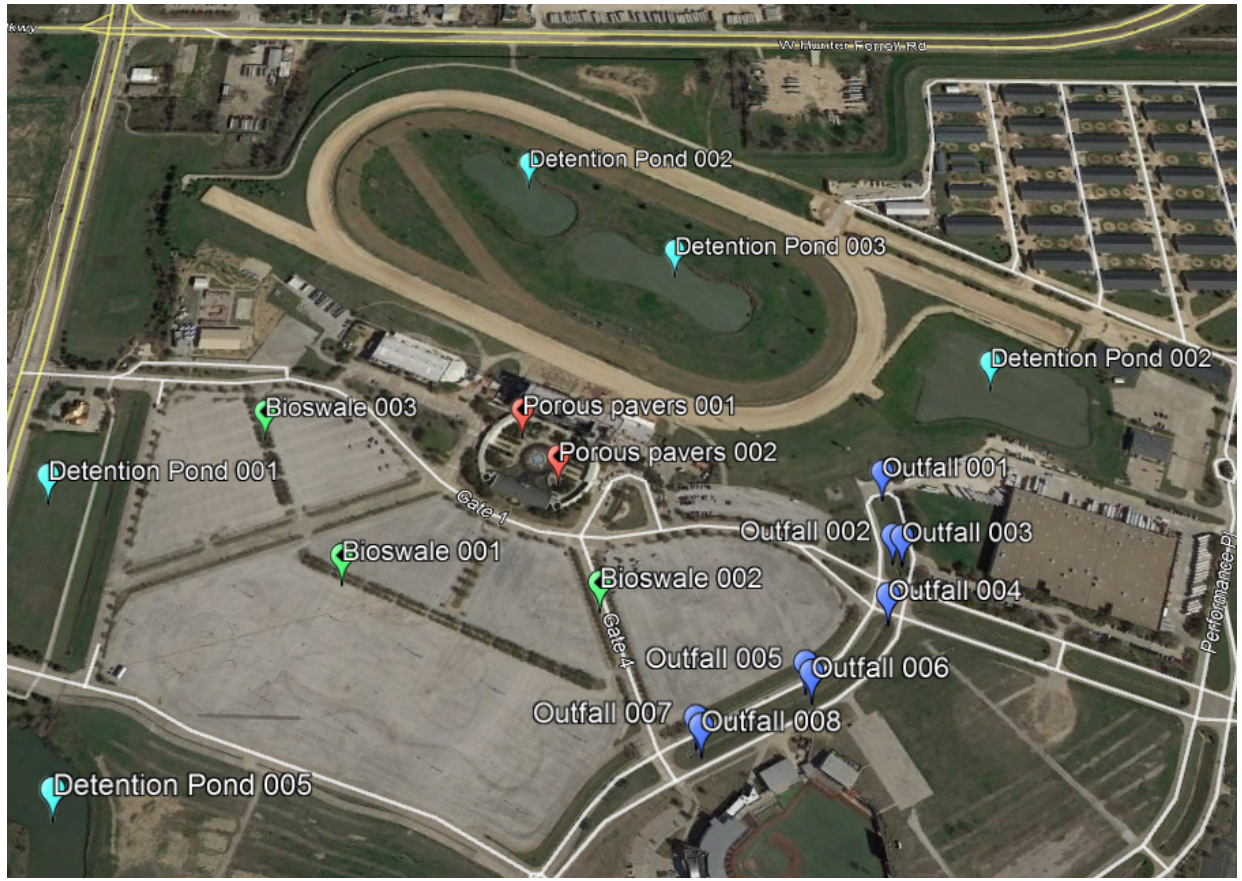
DATA COLLECTION AND GIS INTEGRATION

DRIVERS

- MS4 annual reporting
  - Managing stormwater BMP facility inspection and illicit discharge programs is a challenge.
  - Streamline field data collection and reporting
- Asset management cycle
  - Typically requires a scheduled condition assessment
- Public-private cooperation
  - Joint maintenance efforts between City and Private landowners



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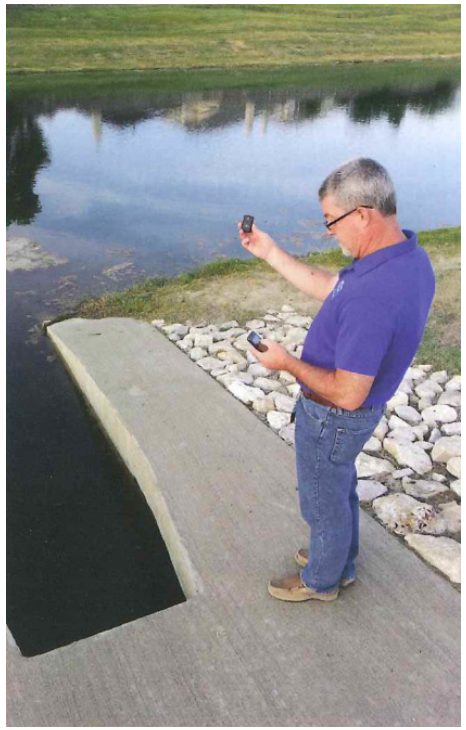
CONDITION MONITORING - EXAMPLES

CONDITION MONITORING - EXAMPLE

GRAND PRAIRIE – DETENTION POND INSPECTION AND MAINTENANCE PROGRAM

- Inspection criteria
- Platform and organization – hard copy and/or mobile forms, with spreadsheet, GIS, etc.
- How Grand Prairie is using the data –
  - MS4 annual reporting
  - Maintenance prioritization
  - Photos/sample data or forms
  - Joint maintenance efforts between City and Private landowners



Stormwater Detention Basin Maintenance Inspection

Date of Inspection	
Inspector Name	
Location of Inspection	
Owner/Manager	
Type of Basin	☐ Wet Detention ☐ Dry Detention

Detention Basin Maintenance

Inspection Item	Date Removed/Repaired/ Completed	N/A	Comments
Remove trash and debris from detention pond area			
Remove woody vegetative growth from pond area including embankments			
Remove trash and debris around discharge structures			
Remove obstructions from pipes, inlets, or outlets			
Mow grassed slopes (wet detention) and basin floor (dry detention)			

Detention Basin Structural Maintenance

Repair erosion to outfalls, spillways, structures, pipes, and embankments			
Repair and/or replace damaged or non-operational structures, such as risers, pipes, headwalls and aeration devices			
Remove vegetation overgrowth and debris from overflow spillway and grates			
Inspect and remove invasive plants			
Observe and note sedimentation levels			
Dredge pond on a 5-10year cycle to retain design capacity			

CONDITION MONITORING - EXAMPLE

GRAND PRAIRIE – DETENTION POND

MAINTENANCE EXAMPLES

MOBILE DATA COLLECTION AND GIS INTEGRATION

CONDITION MONITORING EXAMPLE

FORT WORTH – CHANNEL INSPECTION AND MAINTENANCE PROGRAM

- Monitoring by mapsheds (channels and structures)
- Platform and organization – Halff mobile platform, cloud database, ArcGIS, etc.
- Process management tools (PMTs) –
  - Solutions for data management and interaction
  - Tie geospatial and tabular data
  - Use databases, GIS, web browsers with role-based security, and the Halff GIS iOS mobile app

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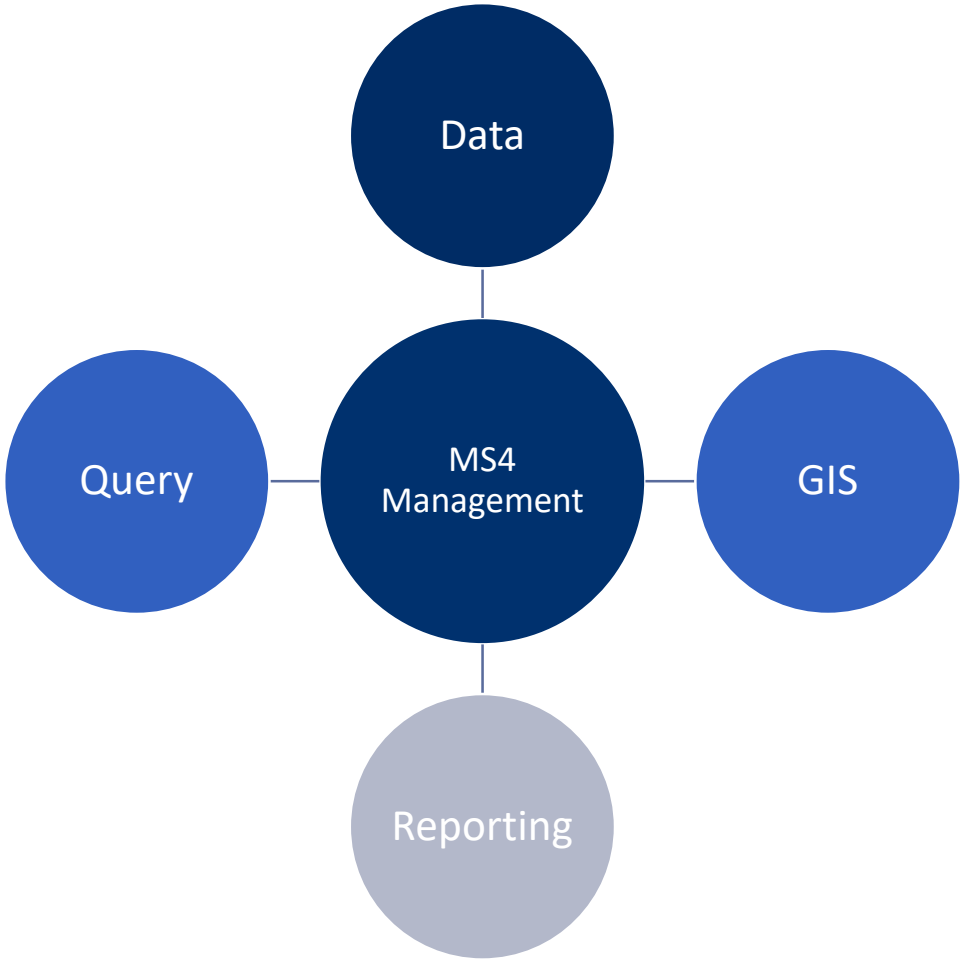
MOBILE DATA COLLECTION AND GIS INTEGRATION

BENEFITS

- Digital data
  - Data collected digitally is ready for reporting
- Tabular format
  - Easy to query, filter, summarize, map
- Improved efficiency
  - Fewer steps
  - Data entered only once
  - Standardized data schema/responses
- Streamlined MS4 management



ASSET MANAGEMENT – GETTING STARTED & WORK ORDER STRATEGIES

ASSET MANAGEMENT – GETTING STARTED & WORK ORDER STRATEGIES

ASSET MANAGEMENT - 5 KEY QUESTIONS

What do I own/maintain/track?

What condition is it in?

How do I prioritize/administer?

What is my funding/strategy?

How does it perform per my Level of Service?

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ASSET MANAGEMENT – GETTING STARTED & WORK ORDER STRATEGIES

CYCLE OF ASSET MANAGEMENT

- Establish program needs and goals
- Start with one or two elements

ASSET MANAGEMENT – GETTING STARTED & WORK ORDER STRATEGIES

RISK-BASED PRIORITIZATION

- Risk framework:
  - Likelihood of failure
  - Consequence of failure
- Risk score prioritizes assets for scheduled inspection
- Condition and consequence of failure informs decisions about renewal and maintenance.

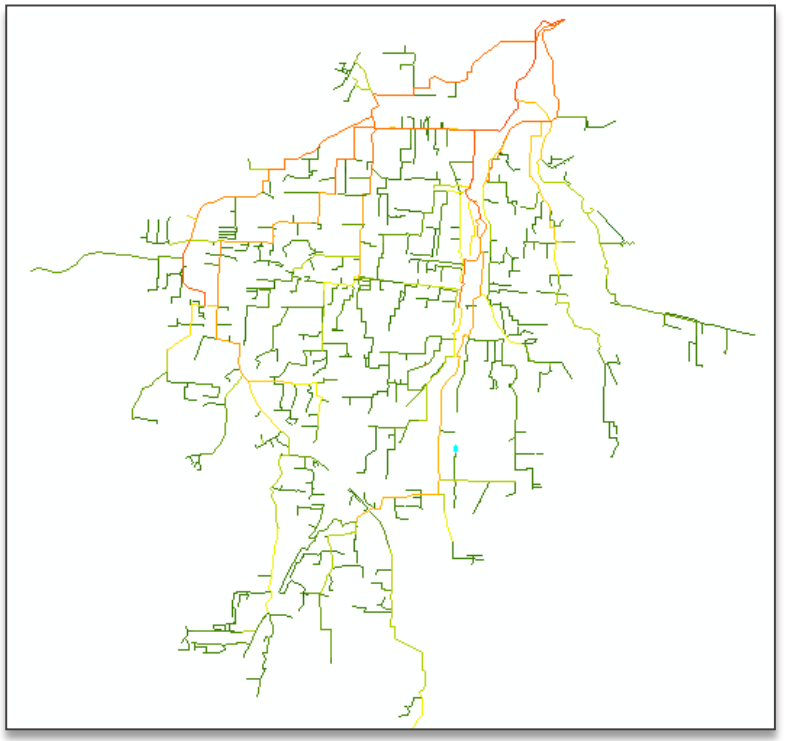
RISK-BASED FRAMEWORK FOR CONSIDERATION

Probability of Failure	Consequence of Failure: High	Consequence of Failure: Moderate	Consequence of Failure: Low
High	Immediate Rehab/Replace	Programmed Rehab/Replace	Repair/Replace on Failure
Moderate	Programmed Rehab/Replace	Proactive Assessment	Monitor and Forecast
Low	Proactive Assessment	Opportunistic Assessment/ Forecasting	Monitor and Forecast

ASSET MANAGEMENT – GETTING STARTED & WORK ORDER STRATEGIES

HOW TO GET STARTED

- Asset management cycle - define it for your program
- Condition assessment data - how will you use it?
- Inspection criteria - use existing forms
- Digital forms – build on data platform with mobile capability
- Platforms - basic/free to complex/cost
- Prioritize assets - for inspection, risk-based, work orders, etc.
- Schedule and perform inspection and data QC
- Feed data into asset management cycle – GIS updates, likelihood of failure, risk prioritization, capital planning



ASSET MANAGEMENT – GETTING STARTED & WORK ORDER STRATEGIES

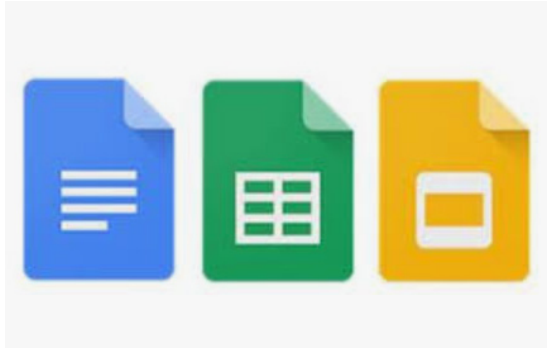
WORK WITH WHAT YOU HAVE

- Asset Management ≠ CMMS (Computerized Maintenance Management System)!
  - Expensive software is not needed to get started
  - Defining/integrating an asset management framework into your program is the key to success
  - Successful asset management requires an organized system to:
    - track location, attributes, and condition of assets
    - optimize performance, value, and efficiency of assets
    - extend remaining useful life of assets
    - prioritize repair and replacement of assets

ASSET MANAGEMENT – GETTING STARTED & WORK ORDER STRATEGIES

WORK ORDER STRATEGIES

- Sample workflows/toolchains
- Basic/free
  - Google Docs
  - ODK Collect
- Complex/cost
  - ArcGIS
  - CMMS – Cityworks, Maximo, Elements XS, others



ISWM WORKSHOP

DECEMBER 4, 2018

STORMWATER BMP MAINTENANCE

CONTACT INFORMATION & WORKSHOP MATERIALS

NCTCOG	TAMARA COOK	TCOOK@NCTCOG.ORG
	MYRA LOPEZ	MLOPEZ@NCTCOG.ORG
	MIA BROWN	MBBROWN@NCTCOG.ORG
A&M AGRILIFE	DR. FOUAD JABER	FOUAD.JABER@AG.TAMU.EDU
ECO SERVICES	ANTHONY KENDRICK	KENDRICK@ECOSVS.COM
	DAN CONAWAY	CONAWAY@ECOSVS.COM
URBAN ECOPLAN	MIKEL WILKINS	MIKEL@URBANECOPLAN.COM
HALFF	BEN PYLANT	BPYLANT@HALFF.COM
	MATT STAHL	MSTAHL@HALFF.COM

*WORKSHOP MATERIALS, ISWM WEBSITE - HTTP://ISWM.NCTCOG.ORG/

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