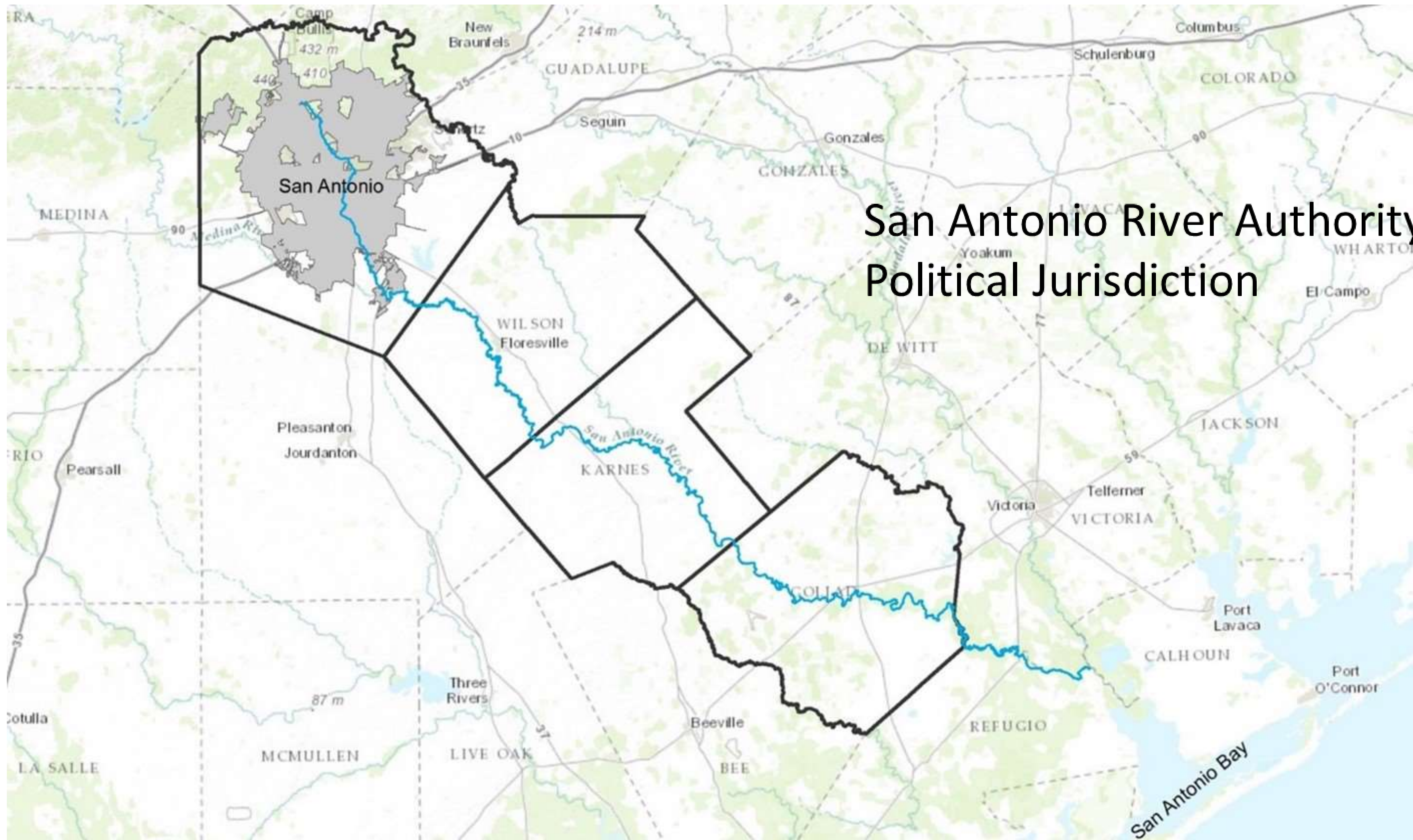




Making Designing for River Water Quality an Easier Option

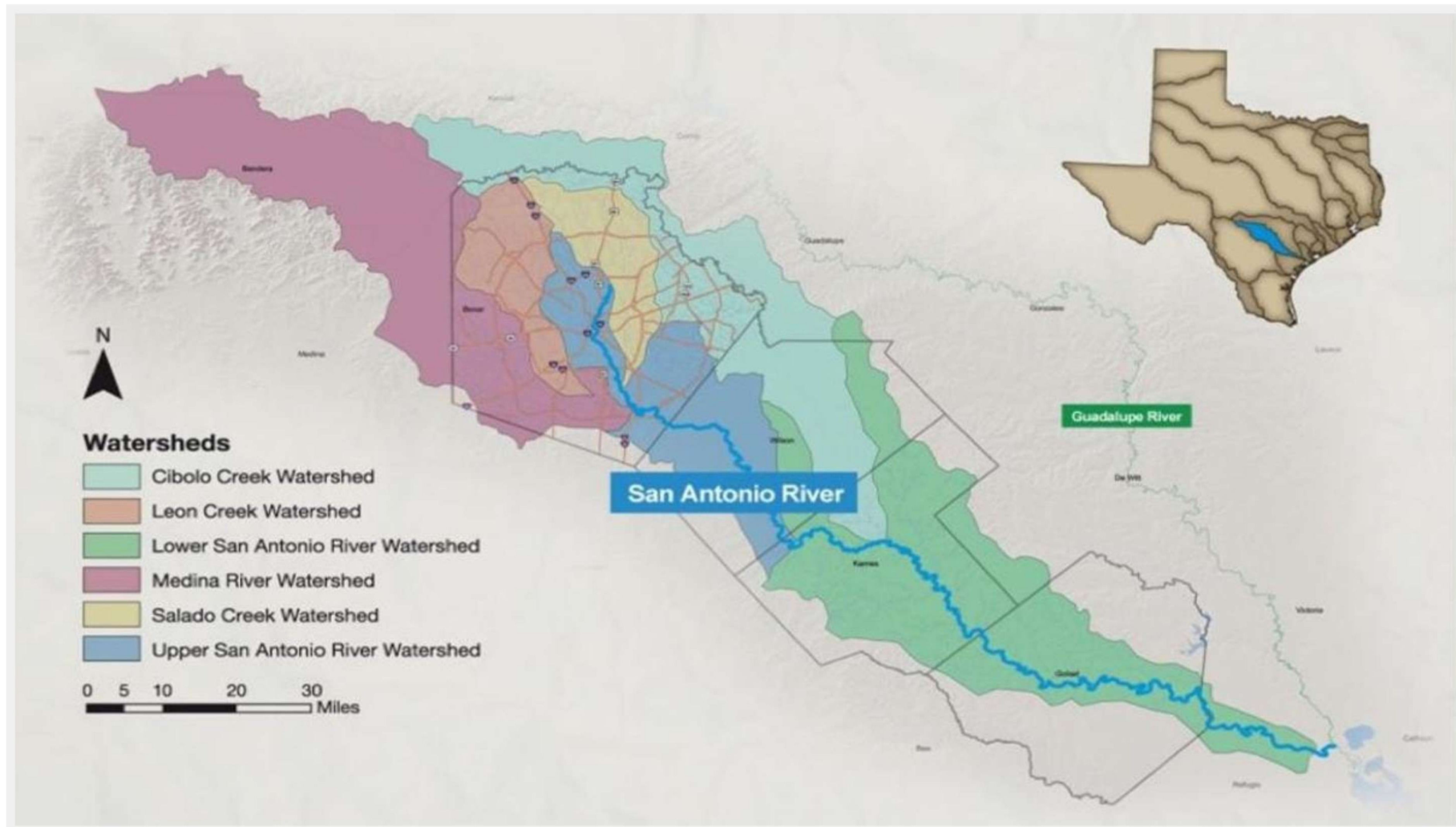
Presented at UGRA / Kerr County Extension Seminar on September 12, 2019



San Antonio River Authority Political Jurisdiction



San Antonio River Basin



Low Impact Development (LID)

A site-planning and design approach that

- manages stormwater runoff close to its source
- provides water quality treatment
- treats stormwater as a resource instead of a nuisance
- mitigates negative downstream impacts of stormwater runoff, such as erosion to rivers, creeks, and infrastructure.



Permeable Pavement



Bioretention



Bioswales



Stormwater Cisterns



SA River Authority-funded LID Incentives

- Watershed Wise Rebate
- Watershed Wise School Grant



Rebates

Watershed Wise Rebate

- Available for Bexar, Wilson, Karnes and Goliad counties
- Application Period: September 2 - 30, 2019
- Rebate for construction of Low Impact Development practices on new or retrofit projects
- The minimum reimbursement request is \$15,000 and the maximum is \$100,000.
- Funds are paid after project is complete and inspected.



Rebates

- Rebate Agreement required
 - Maintenance period
- LID courses required:
 - design
 - construction inspection
 - annual maintenance

New
This
Year



Rebates

- Ranking Criteria
 - Priority Sub-Watersheds
 - Direct Impact to Receiving Water Body
 - Treatment Percentage
- Demand is greater than funding.



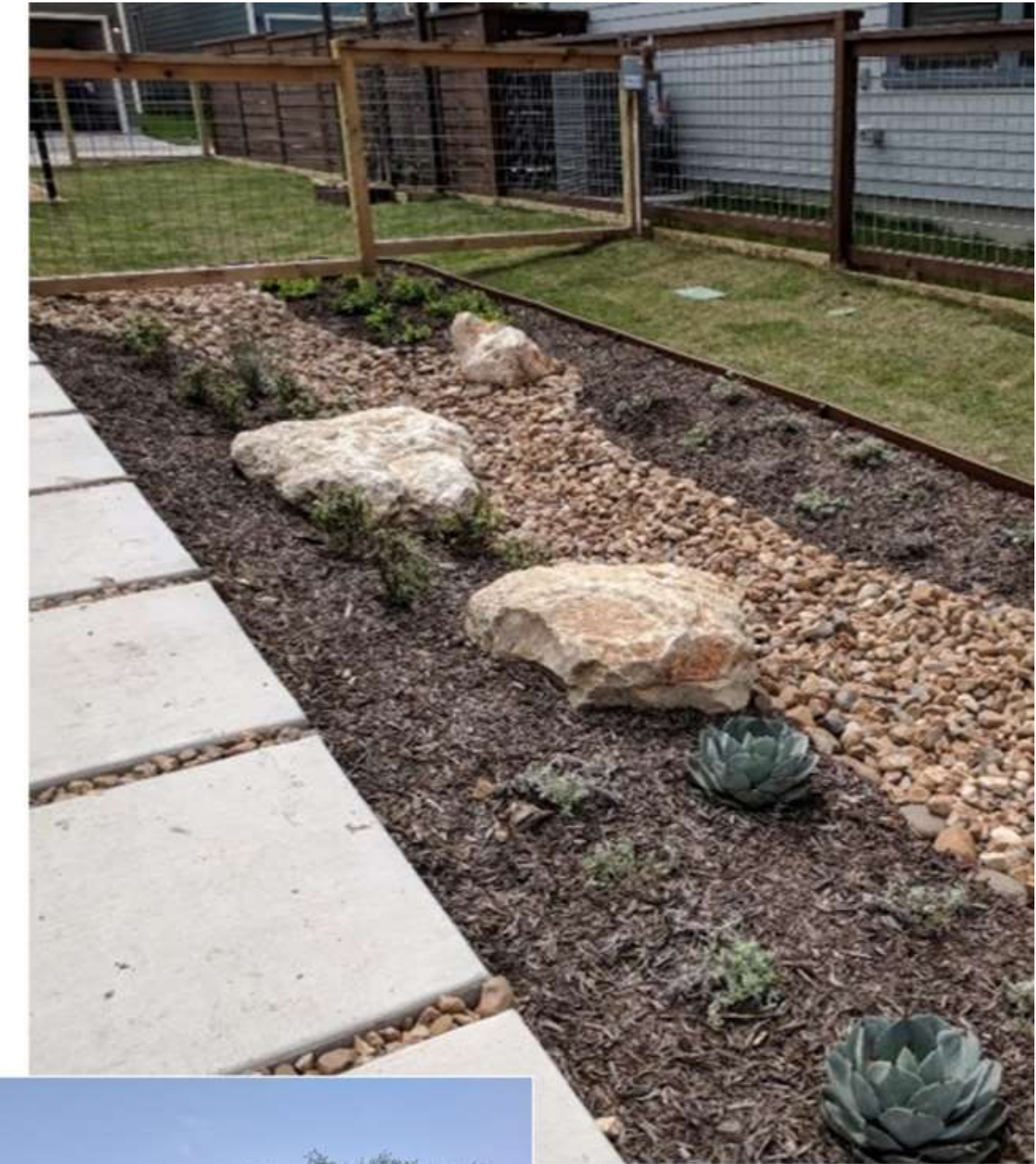
Rebates

- Budget

•FY 2015/16	\$350,000	4 Projects
•FY 2016/17	\$520,000	8 Projects
•FY 2017/18	\$425,000	6 Projects
•FY 2018/19	<u>\$476,312</u>	<u>8 Projects</u>
	\$1,771,312	26 Projects

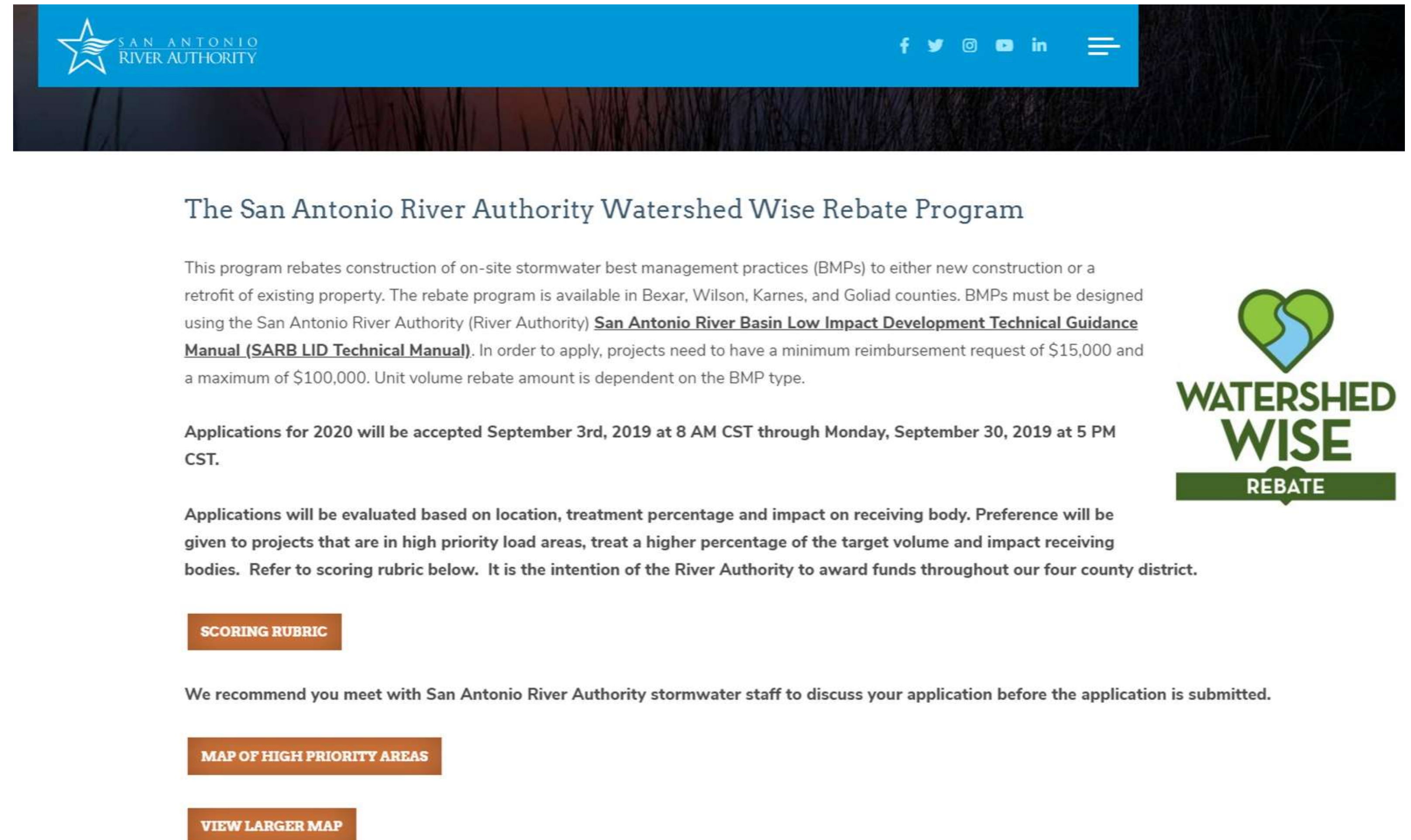
- Mix: 13 Public, 13 Private

- 13 Projects Completed



Rebates

- Application materials at www.sara-tx.org
 - Click **Be River Proud**
 - Click **Watershed Wise**
 - Click **Rebates**



The San Antonio River Authority Watershed Wise Rebate Program

This program rebates construction of on-site stormwater best management practices (BMPs) to either new construction or a retrofit of existing property. The rebate program is available in Bexar, Wilson, Karnes, and Goliad counties. BMPs must be designed using the San Antonio River Authority (River Authority) [San Antonio River Basin Low Impact Development Technical Guidance Manual \(SARB LID Technical Manual\)](#). In order to apply, projects need to have a minimum reimbursement request of \$15,000 and a maximum of \$100,000. Unit volume rebate amount is dependent on the BMP type.

Applications for 2020 will be accepted September 3rd, 2019 at 8 AM CST through Monday, September 30, 2019 at 5 PM CST.


Applications will be evaluated based on location, treatment percentage and impact on receiving body. Preference will be given to projects that are in high priority load areas, treat a higher percentage of the target volume and impact receiving bodies. Refer to scoring rubric below. It is the intention of the River Authority to award funds throughout our four county district.

[SCORING RUBRIC](#)

We recommend you meet with San Antonio River Authority stormwater staff to discuss your application before the application is submitted.

[MAP OF HIGH PRIORITY AREAS](#)

[VIEW LARGER MAP](#)



School Grants

- Competitive
- K-12 public schools
- Part of grant award:
 - Design professional
 - Grant agreement
 - Maintenance period
 - Signage package
 - Construction Inspection

Before LID



After LID



School Grants

- Budgets

•FY 2014/15	\$ 50,000	2 Schools
•FY 2015/16	\$100,000	4 Schools
•FY 2016/17	\$ 75,000	3 Schools
•FY 2017/18	\$ 75,000	3 Schools
•FY 2018/19	<u>\$ 75,000</u>	<u>3 Schools</u>
	\$375,000	15 Schools

- 11 projects completed; four underway



New Rebate/Grant Inspection Program

Bioretention Maintenance Protocol

1 DESCRIPTION OF BIORETENTION

Bioretention areas are landscaped shallow depressions that capture and temporarily store stormwater runoff which is filtered through the soil media to remove pollutants. Bioretention areas usually consist of an inlet, a ponding area, mulch layer, planting soil media, native plants, an overflow device, or underdrain.



Figure 1. Examples of bioretention

2 SUMMARY OF PROTOCOL

Bioretention areas require regular plant, soil, and mulch layer maintenance to ensure optimum infiltration, storage, and pollutant-removal capabilities. Inlets, overflow drains, and underdrains, if components of your bioretention design, also require inspection and maintenance to ensure proper function. Table 1 provides a detailed list of maintenance activities and Table 2 is a checklist that will guide field personnel in identifying the appropriate outcomes of maintenance activities.

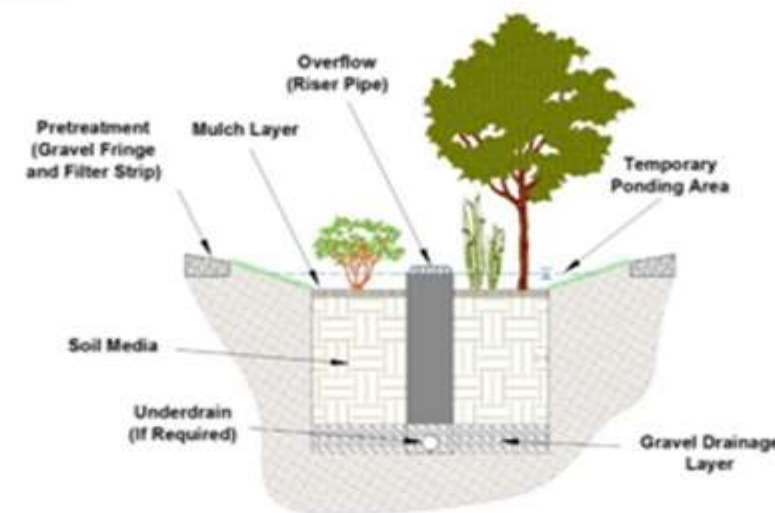


Figure 2. Schematic of bioretention highlighting the ponding area and overflow area. (Not all systems have the riser pipe.)

3 DESCRIPTION OF MAINTENANCE TASKS

- Mulch:** Maintain a 2 to 3-inch depth of dimensional chipped hardwood mulch, or triple-shredded hardwood mulch. Periodically, the mulch layer should be broken up and raked out, as over time it tends to solidify into a solid mass with reduced capacity for infiltration. Mulch should be completely replaced every 2 to 5 years.



Figure 3. Maintain 2 to 3 inches of mulch

- Plant Material and Weeding:** Replace all dead plants, and if specific plants have a high mortality rate, assess the cause. If necessary, replace with more appropriate native species. Periodic weeding is necessary until plants are established. The weeding schedule can become less frequent if the appropriate plant species and planting density have been used and, as a result, undesirable plants are excluded. Prune as necessary to maintain the desired aesthetic.



Figure 4. Example of vegetation growth that eliminates the need to weed. Woolly Star, shown, and Gulf Muhly are well suited to bioretention.



Maintenance Activities Sheet

Task	Frequency	Indicator maintenance is needed	Maintenance notes
Catchment inspection	Weekly or biweekly with routine property maintenance	Excessive sediment, trash, or debris accumulation on the surface of bioswale	Permanently stabilize any exposed soil and remove any accumulated sediment. Adjacent pervious areas might need to be regraded.
Inlet inspection	Weekly or biweekly with routine property maintenance	Internal erosion or excessive sediment, trash, and/or debris accumulation	Check for sediment accumulation to ensure that flow into the bioswale is as designed. Remove any accumulated sediment.
Litter and leaf litter removal	As needed potentially weekly or biweekly in peak seasons	Accumulation of litter and leafy debris within bioswale	Litter and leaves should be removed to reduce the risk of outlet clogging, to reduce nutrient inputs to the bioswale, and to improve facility aesthetics.
Pruning	1–2 times per year	Overgrown vegetation that interferes with access, lines of sight, or safety	Nutrients in runoff often cause bioswale vegetation to flourish.
Mowing	2–12 times per year	Overgrown vegetation that interferes with access, lines of sight, or safety	Frequency depends on location and desired aesthetic appeal.
Mulch removal and replacement	1 time per 2–3 years	Less than 3 inches of mulch remains on surface	Mulch accumulation reduces available surface water storage volume. Removal of decomposed mulch also increases surface infiltration rate of fill soil. Remove decomposed fraction and top off with fresh mulch to a total depth of 3 inches
Temporary Watering	1 time per 2–3 days for first 1–2 months, sporadically after established	Until established and during severe droughts	Watering after the initial year might be required.
Remove and replace dead plants	1 time per year	Dead plants	Plant die-off tends to be highest during the first year (commonly 10% or greater). Survival rates increase with time.
Outlet inspection	Once after first rain of the season, then monthly during the rainy season	Erosion at outlet	Remove any accumulated mulch or sediment.
Miscellaneous upkeep	12 times per year	Tasks include trash collection, plant health, spot weeding, removing invasive species, and removing mulch from the overflow device.	



Inspection and Maintenance Checklist

Inspection and Maintenance Checklist BIOSWALE	Property Address _____
	Property Owner _____
	Treatment Measure No. _____ Inspection Date _____
	Inspector(s) _____
	Type of Inspection: <input type="checkbox"/> Monthly <input type="checkbox"/> Pre-wet season <input type="checkbox"/> Post-wet season <input type="checkbox"/> After heavy runoff <input type="checkbox"/> Other: _____

Defect	Conditions when maintenance is needed	Maintenance needed?	Comments ^a	Results expected when maintenance is performed
1. Standing water	Water in the bioswale does not drain within 24 hours after rainfall.			There should be no areas of standing water once inflow has ceased. Any of the following could apply: sediment or trash blockages need to be removed, grade from head to foot of the bioswale improved, media surface scarified, or underdrains flushed.
2. Trash and debris	Trash and debris accumulate in the bioswale and around the inlet and outlet.			Trash and debris are removed from the bioswale and disposed of properly.
3. Sediment	Sediment accumulates in the bioswale			Material is removed such that that there is no clogging or blockage. Material is disposed of properly.
4. Erosion	Channels have formed around inlets, there are areas of bare soil, or there is other evidence of erosion.			Obstructions and sediment are removed so that water flows freely and disperses over a wide area. Obstructions and sediment are disposed of properly.
5. Vegetation	Vegetation is dead, diseased or overgrown.			Vegetation is healthy and attractive. Grass is maintained at least 3 inches in height.
6. Mulch	Mulch is missing or patchy. Areas of bare earth are exposed or mulch layer is less than 3 inches deep.			All bare earth is covered, except mulch is kept 6 inches away from trunks of trees and shrubs. Mulch is even at a depth of 3 inches.
7. Inlet/outlet	Sediment accumulations.			Inlet/outlet is clear of sediment and debris and allows water to flow freely.
8. Miscellaneous	Any condition not covered above that needs attention for the bioswale to function as designed.			The design specifications are met.



Inspections Findings

- Weeding and grass removal
- Native plant understanding
- Water volume / infiltration
- Cistern maintenance



LID Results: Completed Rebates & Grants

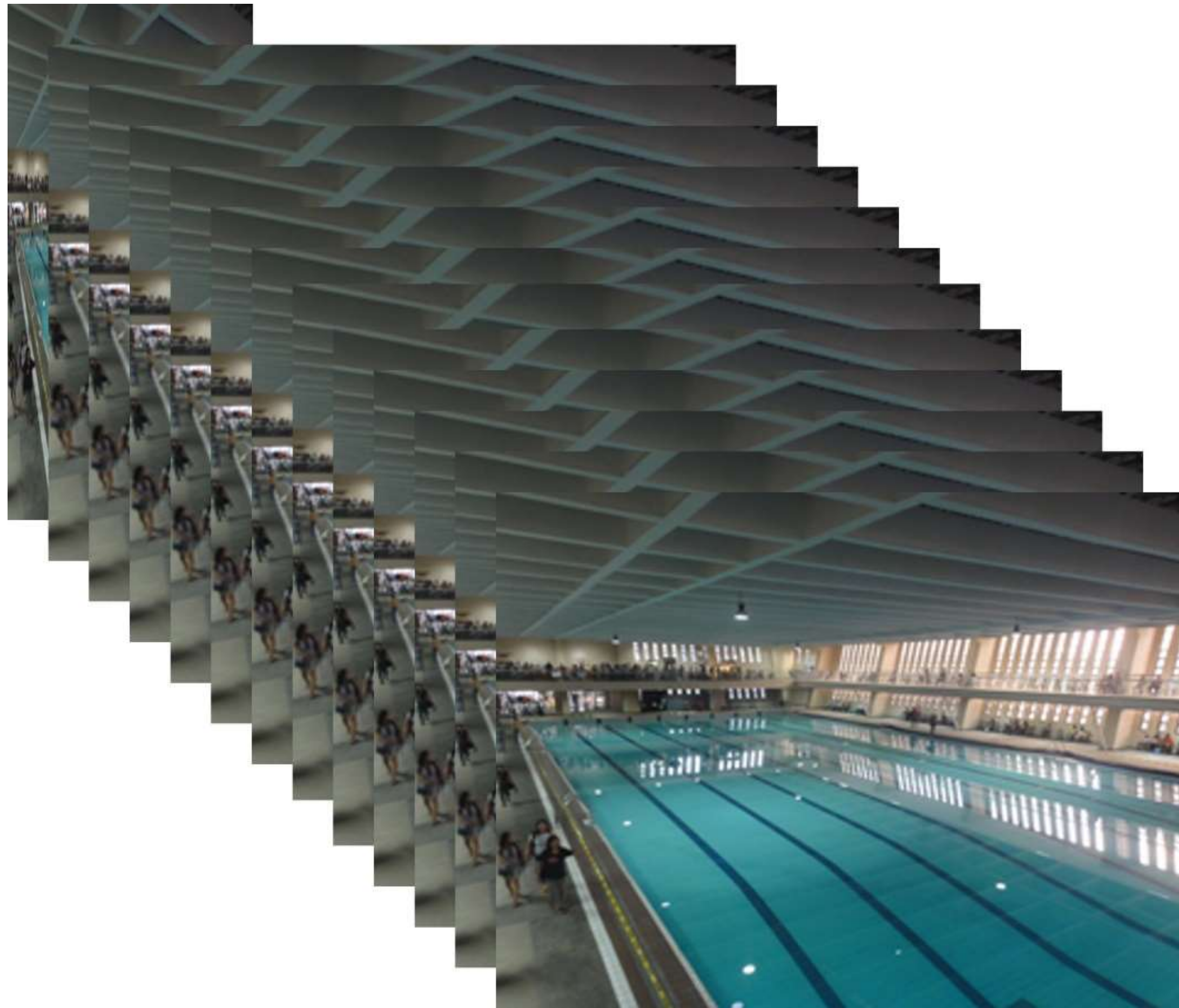
Project ID	BMP ID	BMP Type	Impervious Area (SF)	Treated Volume (CF)	Annual Volume Treated (CF)	Bacterial Load Removed (Colonies/yr)	TSS Load Removed (lb/yr)	County	Rebate/Grant Award
WWRO01	8001	Confluence Park	25354	6338	66695	9.1E+11	187.4	Bexar	\$ 100,000.00
WWSG04	8035	Bellaire ES	6000	1107	15264	1.8E+11	37.7	Bexar	\$ 25,000.00
WWSG07	8041	Brackenridge HS	4500	128	4782	5.7E+10	11.8	Bexar	\$ 25,000.00
WWSG07	8042	Brackenridge HS	4500	128	4782	5.7E+10	11.8	Bexar	
WWSG07	8043	Brackenridge HS	4500	128	4782	5.7E+10	11.8	Bexar	
WWRO24	8027	District Fitness	9464	1267	22677	2.7E+11	56.1	Bexar	\$ 17,422.63
WWRO02	8002	DSD Parking Lot	31241	3190	69414	8.3E+11	171.6	Bexar	\$ 34,527.28
WWSG03	8031	Five Palms	6928	1085	17150	2.1E+11	42.4	Bexar	\$ 25,000.00
WWSG03	8032	Five Palms	352	44	830	1.1E+10	2.3	Bexar	
WWSG03	8033	Five Palms	352	44	830	1.1E+10	2.3	Bexar	
WWSG03	8034	Five Palms	352	44	830	1.1E+10	2.3	Bexar	
WWRO22	8001	Five Palms	6952	1006	16944	2.0E+11	41.9	Bexar	\$ 53,910.50
WWSG03	8031	Five Palms	2056	514	5408	6.5E+10	13.4	Bexar	
WWSG03	8032	Five Palms	4192	821	10754	1.3E+11	26.6	Bexar	
WWSG03	8033	Five Palms	3560	890	9365	1.1E+11	23.2	Bexar	
WWSG03	8034	Five Palms	1928	267	4655	6.3E+10	13.1	Bexar	
WWSG03	8031	Five Palms	4816	754	11921	1.4E+11	29.5	Bexar	\$ 16,088.01
WWSG03	8032	Five Palms	1264	151	2944	4.0E+10	8.3	Bexar	
WWSG03	8033	Five Palms	1264	151	2944	4.0E+10	8.3	Bexar	
WWSG03	8034	Five Palms	63462	14407	165614	2.0E+12	409.4	Bexar	\$ 100,000.00
WWSG03	8031	Five Palms	10056	2514	26453	3.2E+11	65.4	Bexar	\$ 47,766.00
WWSG03	8032	Five Palms	3016	742	7925	9.5E+10	19.6	Bexar	\$ 100,000.00
WWSG03	8033	Five Palms	2888	644	7523	9.0E+10	18.6	Bexar	
WWSG03	8034	Five Palms	4440	688	10969	1.3E+11	27.1	Bexar	
WWSG03	8031	Five Palms	7720	1072	18651	2.2E+11	46.1	Bexar	
WWSG03	8032	Five Palms	3840	773	9886	1.2E+11	24.4	Bexar	
WWSG03	8033	Five Palms	7744	1207	19153	2.3E+11	47.3	Bexar	
WWSG03	8034	Five Palms	8664	2165	22790	2.7E+11	56.3	Bexar	
WWSG03	8031	Five Palms	31250	949	34992	4.2E+11	86.5	Bexar	\$ 25,000.00
WWSG03	8032	Five Palms	3560	875	9354	1.1E+11	23.1	Bexar	
WWSG03	8033	Five Palms	2400	708	6359	8.6E+10	17.9	Bexar	\$ 25,000.00
WWSG03	8034	Five Palms	31936	3992	75260	1.5E+12	390.0	Bexar	\$ 50,712.01
WWSG06	8038	Rudder MS	5625	350	10082	1.2E+11	24.9	Bexar	\$ 25,000.00
WWSG06	8039	Rudder MS	5625	1002	14233	1.7E+11	35.2	Bexar	
WWSG06	8040	Rudder MS	5625	528	12141	1.5E+11	30.0	Bexar	
WWRO08	8004	DoSeum Parking	18048	4512	47476	5.7E+11	117.4	Bexar	\$ 62,040.00
WWSG02	8029	Herff Elementary	16172	1161	31179	3.7E+11	77.1	Bexar	\$ 25,000.00
WWSG02	8030	Herff Elementary	616	85	1486	2.0E+10	4.2	Bexar	
WWRO16	8009	Kirby Animal Shelter	7352	1705	19225	2.3E+11	47.5	Bexar	\$ 18,555.88
WWRO16	8010	Kirby Animal Shelter	680	80	1577	2.1E+10	4.4	Bexar	
WWSG12	8049	Lamar ES	8000	1020	18945	2.3E+11	46.8	Bexar	\$ 25,000.00
WWRO17	8011	Leon Vista Trailhead Parking	2672	669	7030	8.4E+10	17.4	Bexar	\$ 29,330.11
WWRO19	8014	Urban at Olive	20640	3946	52775	6.3E+11	130.5	Bexar	\$ 54,255.85
			397231	64343	915881	1.2E+13	2,498.2	Bexar	\$ 884,608.27
WWSG10	8046	Goliad ES	2325	441	5938	7.1E+10	14.7	Goliad	\$ 25,000.00
			2325	441	5938	7.1E+10	14.7	Goliad	\$ 25,000.00
WWSG11	8047	Roger E. Sides ES	2030	262	4823	5.8E+10	11.9	Karnes	\$ 25,000.00
			2030	262	4823	5.8E+10	11.9	Karnes	\$ 25,000.00
WWRO10	8005	Wilson Co Parking Lot A	39272	4925	92625	1.1E+12	229.0	Wilson	\$ 70,181.25
WWSG01	8028	Floresville South ES	5000	281	8483	1.0E+11	21.0	Wilson	\$ 25,000.00
WWSG05	8036	Floresville North ES	34075	2168	61840	7.4E+11	152.9	Wilson	\$ 25,000.00
			78347	7374				Wilson	\$ 120,181.25
					162948	1.9E+12	402.8	Wilson	\$ 1,054,789.52
		Table Totals	479933	72420.133	1089590	1.38E+13	2927.56		

New:
A component of
SARA's annual Score
Card

Impervious Area (SF)	Treated Volume (CF)	Annual Volume Treated (CF)	Bacterial Load Removed (Colonies/yr)	TSS Load Removed (lb/yr)
----------------------	---------------------	----------------------------	--------------------------------------	--------------------------



LID Results: Completed Rebates & Grants



Impervious Area (SF)	Treated Volume (CF)	Annual Volume Treated (CF)	Bacterial Load Removed (Colonies/yr)	TSS Load Removed (lb/yr)
479,933	72,420.13	1,089,590	1.38E+13	2,927.56



Formal, Credential Courses

Course	Date
Construction Inspection Registration	Spring Annually
Annual Operations & Maintenance Certification	Spring Annually



www.sara-tx.org



Committed to Safe, Clean, Enjoyable Creeks and Rivers.

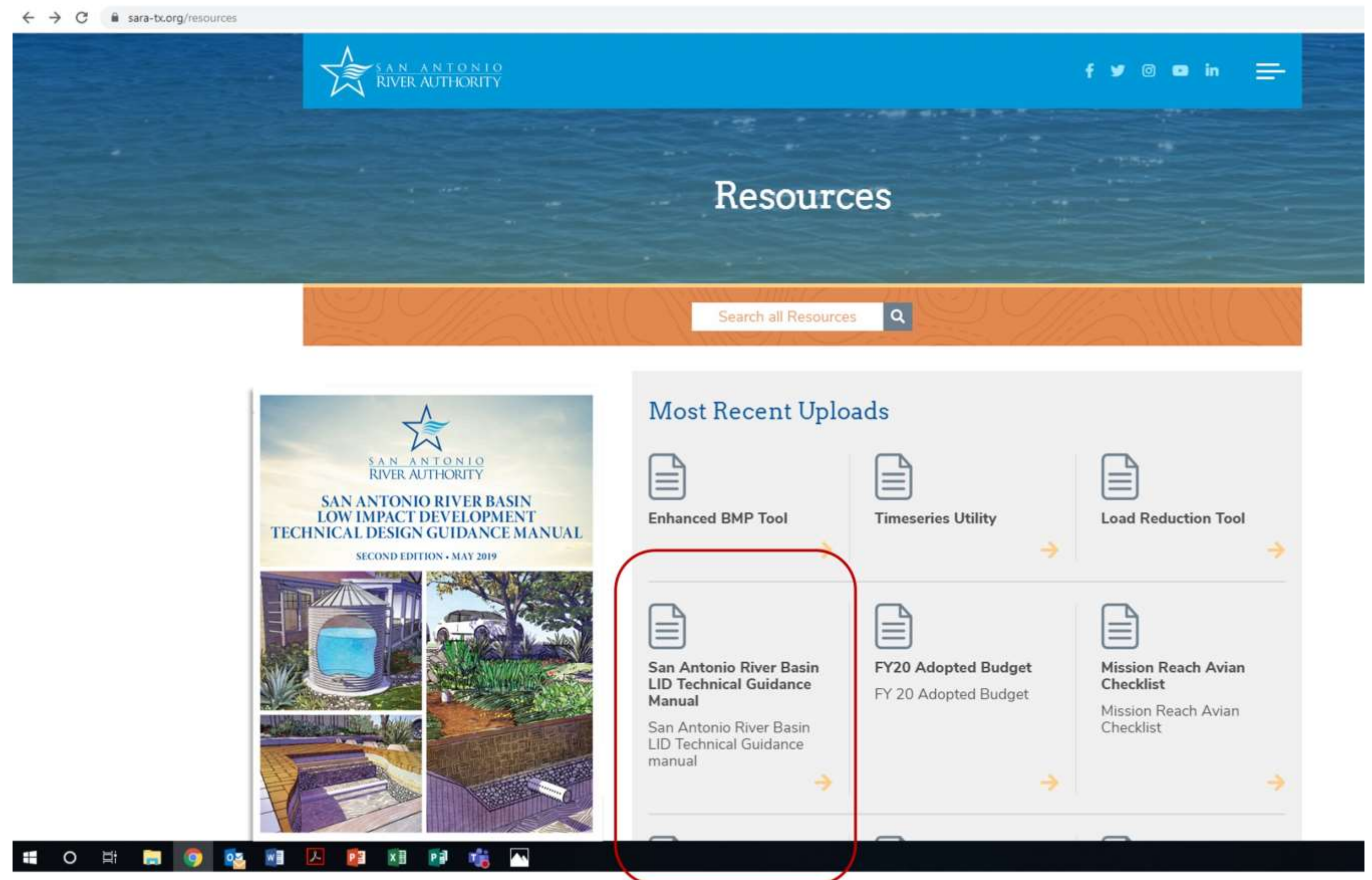
Formal, Credential Course

Coming Soon	Date
<p>Design Course</p> <p>focused on fully integrated LID and designing for maintenance</p>	<p>Fall</p> <p>2019</p>



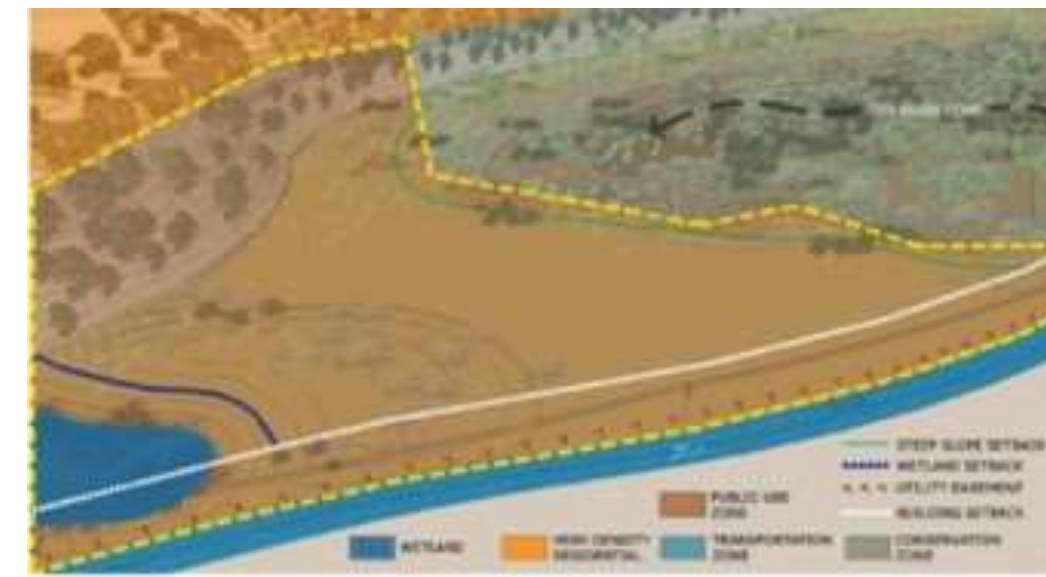
San Antonio River Basin LID Manual

- 2nd issue
- 10th LID feature added:
Extended Detention Pond
- Available at
 - <https://www.sara-tx.org>
 - Click Resources



LID Manual

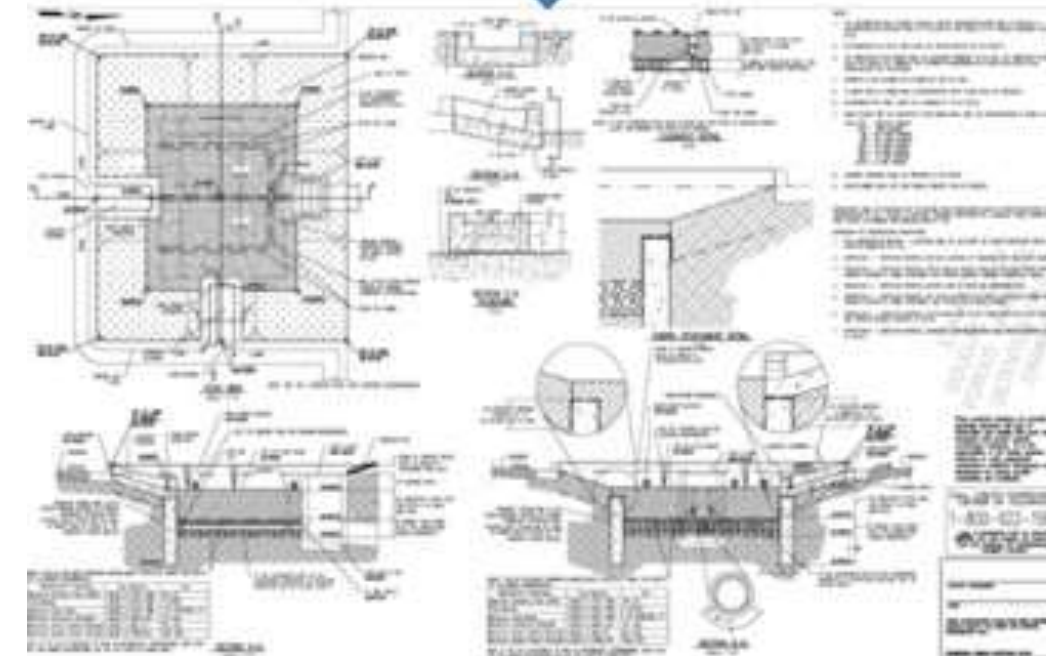
- Iterative process
- Local focus
- Quick reference
- Construction & plan review recommendations
- Operation & maintenance
- Became City of SA Code's Design Standard



Site Analysis



Site Design



BMP Design



2015 Unified Development Code Amendment

- In coordination with City's Transportation & Capital Improvements Department
- Voluntary Development Patterns
 - New LID/Natural Channel Design Use Pattern
 - Includes Proprietary Systems Approved by TCEQ
 - Amended Conservation Subdivision Use Pattern



City's Credit Offset Table

<u>Credit/Offset</u>	Incentive Factor
1. Stream Buffer or Stream Restoration to Parkland Acre	1.5
2. Stream Restoration to Tree Canopy	1.25
3. Linear Park to Parkland Acre	1.5
4. LID BMP to Tree Canopy	1.5
5. LID BMP to Streetscape Tree	1
6. LID BMP Landscape Elective Credit	Up to 25 points
7. LID BMP Drainage Area to Parkland Acre	1.5
8. Density Bonus	10%



City's Fee-based Incentives

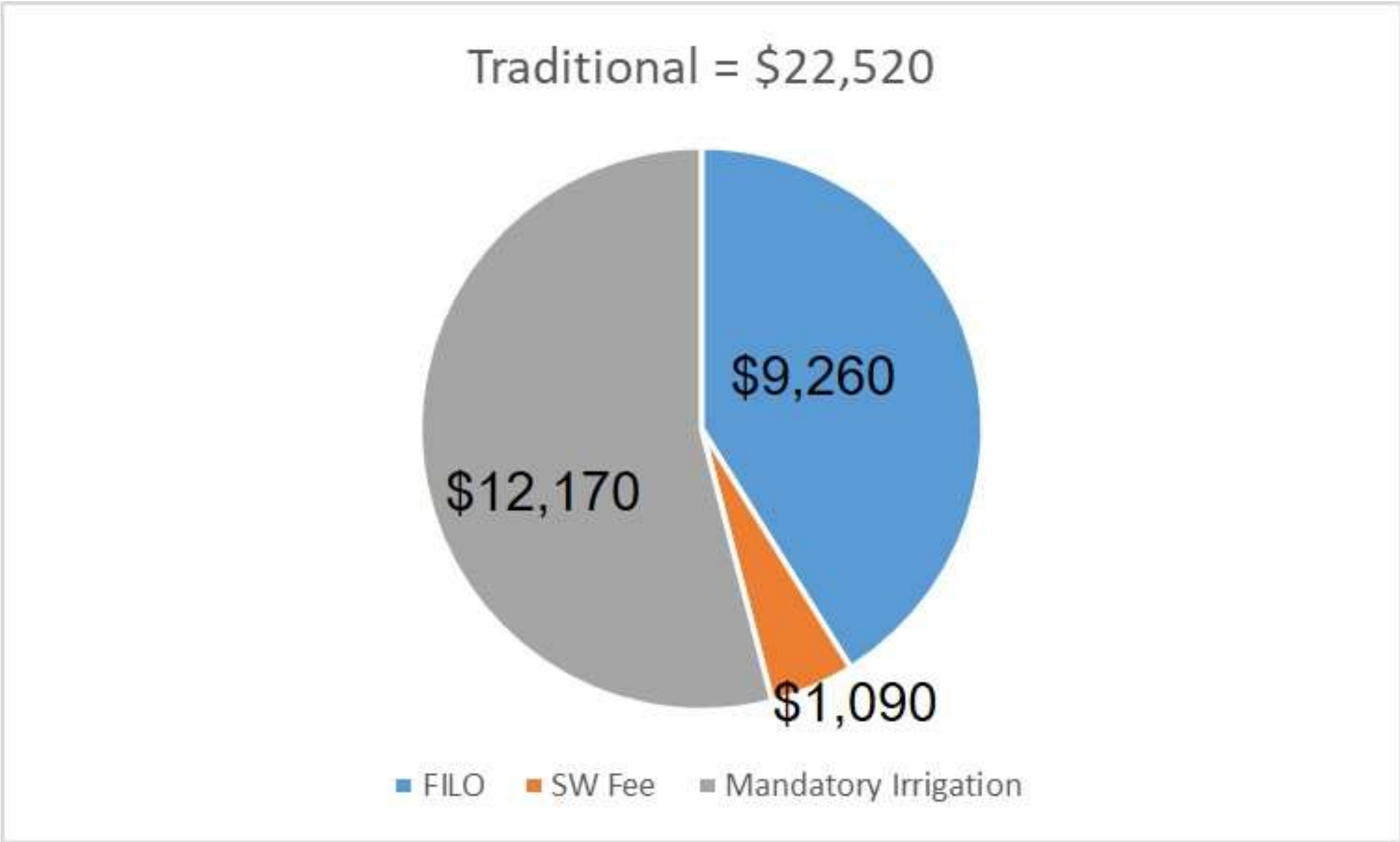
- Fee in Lieu of Discount

	Percent of Water Quality Volume Managed				
	60%	70%	80%	90%	100%
Credit/Offset					
FILO Fee Discount					
Meets LID Performance Standard	5%	10%	20%	25%	30%
Meets Detention Requirements or Increases Channel Storage through NCDP	Cumulative Reduction in Flow Sliding Scale – see 210(j)(1)(C)				

- Other UDC chapters incentivizing LID
 - Permeable Pavement designed to 2-year, 24-hour storm
 - Stormwater Fee Discount



Traditional vs. LID Comparison



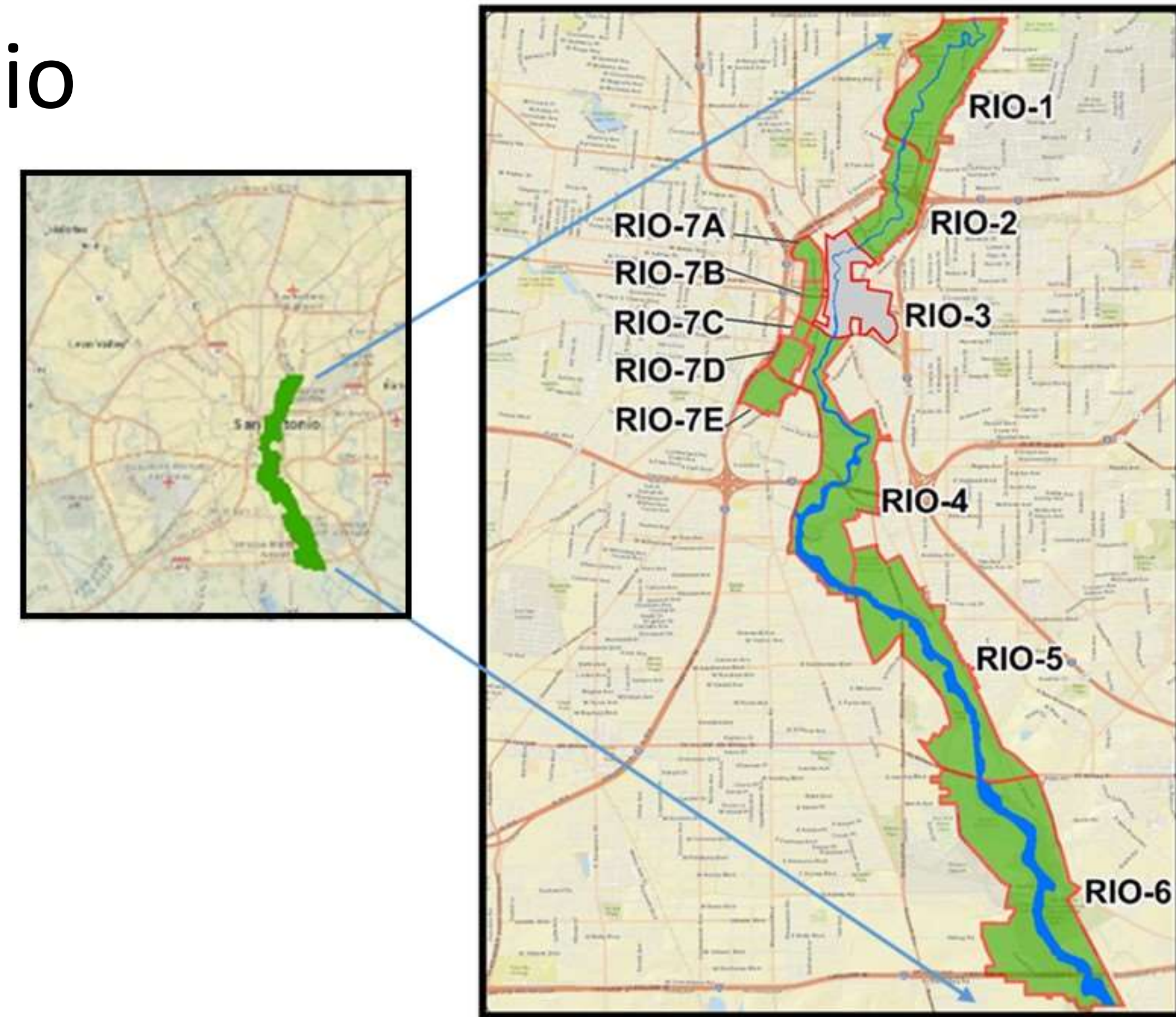
40,000 SF traditional parking lot design compared to LID design with bioswale:
\$15,510 savings with LID.



2015 Unified Development Code Amendment

RIO District **Mandates**

- Properties *abutting* the San Antonio River and San Pedro Creek
- Requires
 - LID
 - Design per SAR Basin LID Manual
 - Coordination with SARA on
 - Drainage along River Walk
 - Ties to River Walk
 - Easements



Website Resources: Rain Gardens



4 How-to Videos

- How to Build a Rain Garden

<https://youtu.be/UXaEfSbjP9Y>

- Perc Test

<https://youtu.be/kYVWh6MuOBJM>

- Rain Garden Blueprint (sizing)

<https://youtu.be/-7SBA8OpSVM>

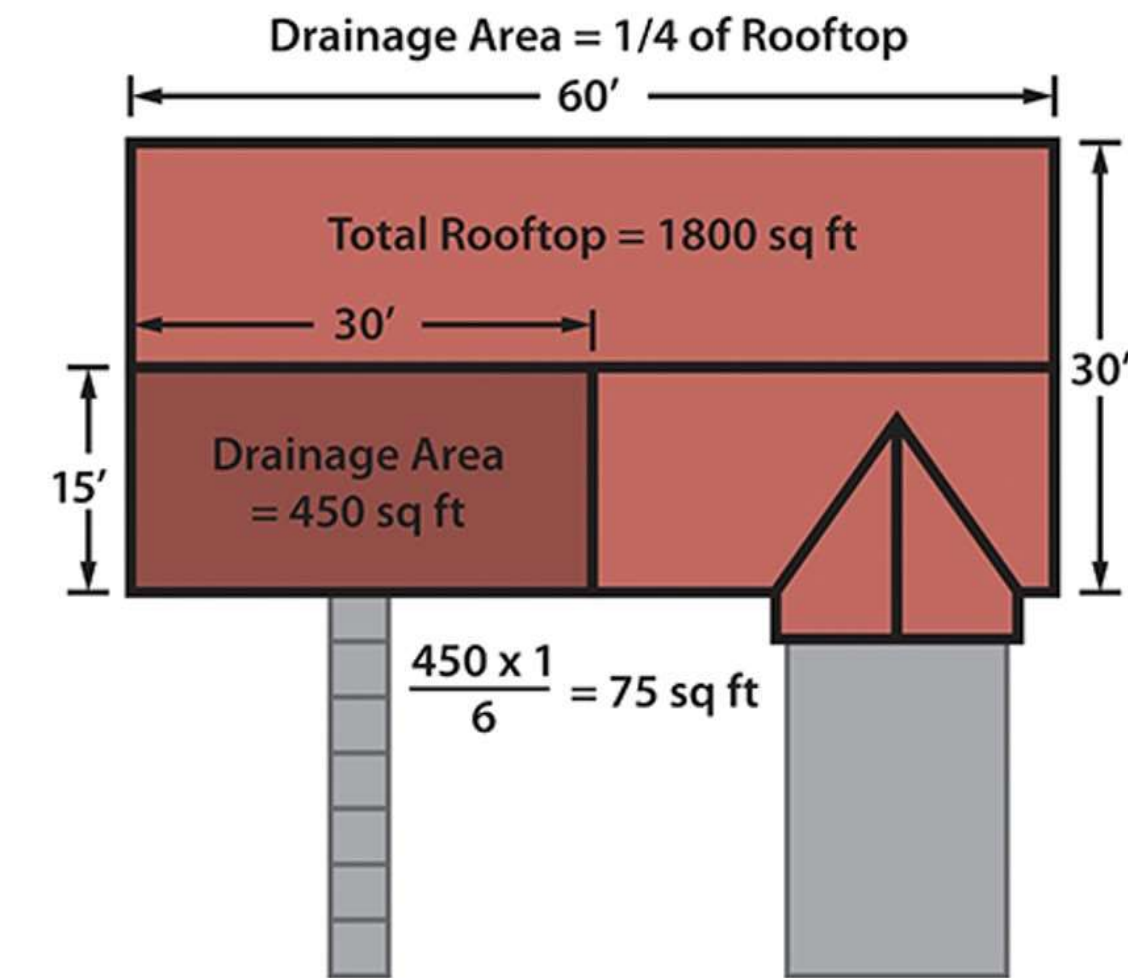
- Digging and Planting

<https://youtu.be/1ihv6zbDuPs>



Website Resources: Rain Gardens

- 311 before digging
- How to get started
- Why and how to do a percolation test
- Options if soil doesn't drain well
- How to size the garden
- How to design for steep slopes

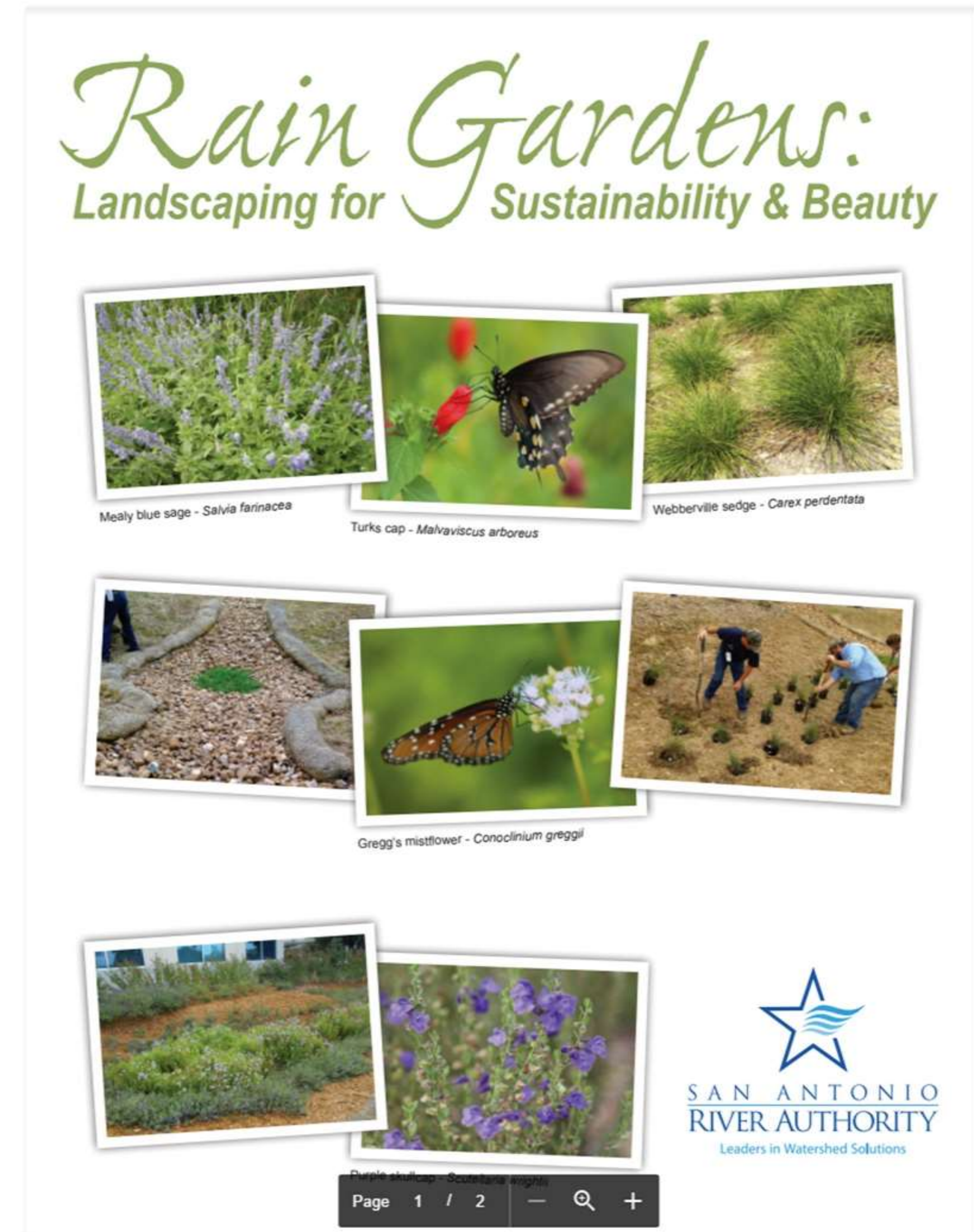


Impervious Surface Area (sq.ft.)	Rain Garden (sq. ft.)	Site Options (ft. x ft.)
200	33	3x11; 4x9
400	67	5x14; 7x10
600	100	5x20; 8x12
800	133	6x22; 10x13
1000	167	6x28; 10x17



Website Resources: Rain Garden Plant Lists

- Bexar County
- Wilson, Karnes, Goliad counties
- Rain garden conditions
 - Moisture: wet, medium, dry
 - Exposure: Sun, partial, shade
 - Soil: caliche, clay, loam, sand
- Owner preferences
 - Height
 - Bloom
 - Bloom period



Questions?

Karen Bishop

Senior Supervisor

Stormwater Unit

San Antonio River Authority

(210) 302-3642

kbishop@sara-tx.org

