

Best Management Practice (BMP) Maintenance Requirements to Ensure Protection of Edwards Aquifer Water Quality

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Project Goals

1. Assess the maintenance status for BMPs in the Edwards Aquifer contributing zone within Bexar County, Texas
2. Identify the differences between the three BMP types in treating pollutants before and after maintenance
3. Conduct a life cycle analysis to interpret the significance of the results on each BMP's:
 - a. Treatment efficacy
 - b. Costs
 - c. Waste streams

Edwards Aquifer

- Karst aquifer in the South-Central Texas
 - Extends 180 miles through ten counties
 - Serves around two million residents
- Divided into three zones
 - Contributing
 - Recharge
 - Artesian
- Aquifer's recharge and contributing zones are vulnerable to urban and agricultural development

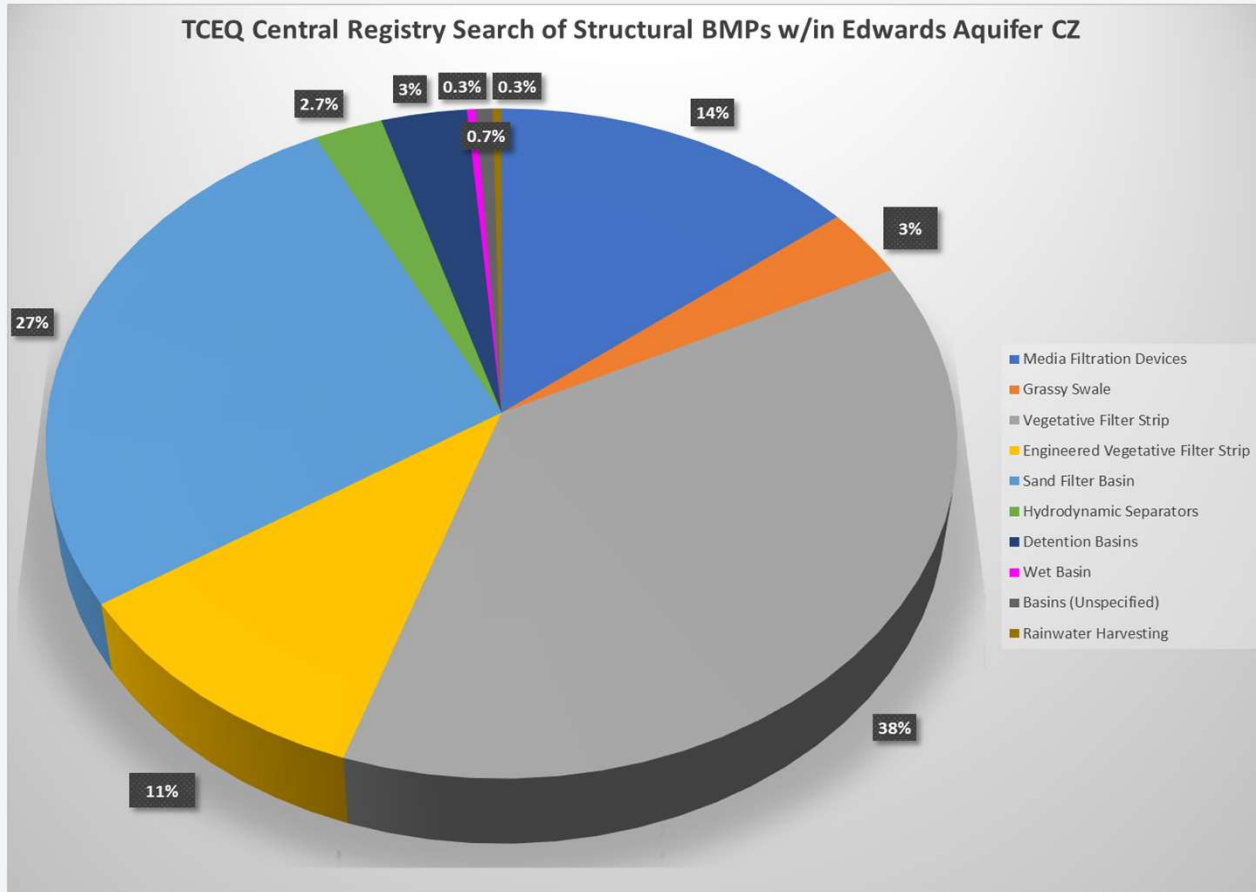


The City of San Antonio

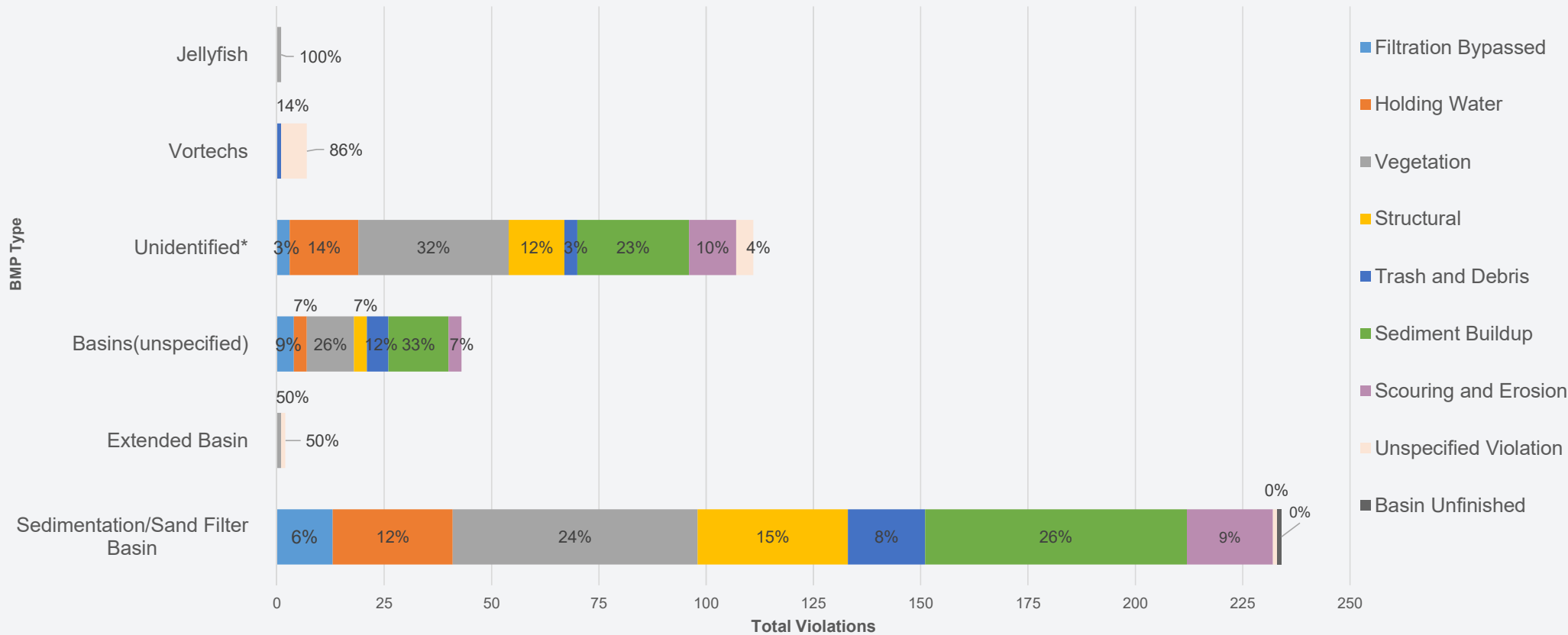
Assessment of Maintenance for BMPs

- TCEQ Registry Search
 - BMP total: 301
- SAWS Database Search
 - BMP total: 208
- Noncompliance
 - Varying issues from 2017-2022
 - 124 different BMPs documented 329 times for initial noncompliance and continued noncompliance at follow-up

TCEQ BMPs



SAWS Noncompliance – Excludes Vegetative BMPS



*BMP type is not identified in database

Compliance Issues study on going – currently lacking private party information – example of other studies.

Table 2. GSI inspection item frequencies (%) for public versus private facilities reporting the number of inspections and various categories of maintenance deficiencies found during inspection

Facility ID	Public (private)				
	Bioretention	Permeable pavement	Sand filter	Infiltration trench	Vegetated swale
Number of inspections	362 (550)	138 (6)	25 (249)	272 (1,418)	94 (27)
Sediment	25.1 (5.1)	15.2 (83.3)	48.0 (43.0)	41.9 (34.1)	11.7 (3.7)
Blockage	16.6 (5.5)	10.1 (0.0)	24.0 (4.8)	18.4 (2.8)	20.2 (0.0)
Access issue	3.6 (0.2)	1.4 (0.0)	16.0 (16.1)	8.5 (0.4)	5.3 (0.0)
Debris	34.8 (5.1)	20.3 (66.7)	60.0 (33.7)	43.0 (11.2)	19.1 (3.7)
Structural	26.2 (17.1)	8.7 (33.3)	28.0 (43.0)	21.3 (26.0)	11.7 (44.4)
Erosion	28.7 (10.4)	2.9 (0.0)	8.0 (0.0)	8.8 (3.1)	9.6 (3.7)
Bare spot	31.5 (6.2)	2.2 (0.0)	20.0 (0.0)	8.5 (4.9)	18.1 (22.2)
Vegetation	12.2 (36.7)	N/A	8.0 (2.4)	1.5 (11.6)	9.6 (25.9)

Identifying Key Factors for Implementation and Maintenance of Green Stormwater Infrastructure

Zack L. DelGrosso, S.M.ASCE¹; Clayton C. Hodges, Ph.D., P.E.²; and
Randel L. Dymond, Ph.D., P.E., F.ASCE³

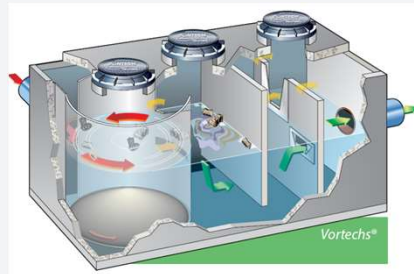
J. Sustainable Water Built Environ., 2019, 5(3): 05019002

Identifying Differences Between 3 BMP Types in Treating Pollutants: BMP Monitoring Sites

Sand Filter Basin



Vortechs



Contech Engineered Solutions, LLC

Jellyfish Filter



Contech Engineered Solutions, LLC

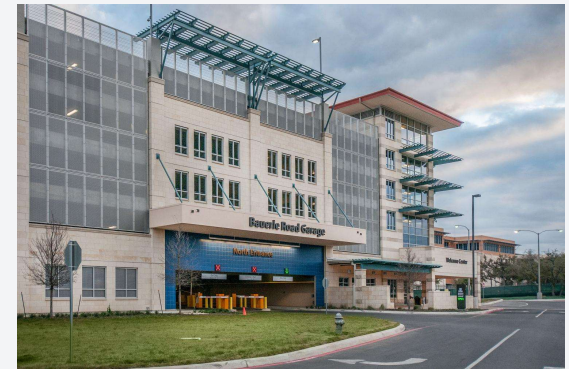
Sand Filter Basin- UTEX Blvd

- Business development over contributing zone
- Various BMPs providing treatment to overall development area
 - Jellyfish, vegetative filter strip
- Treatment area
 - 8.19- acre drainage basin area



Vortechs- Bauerle Rd. Garage

- Vortechs hydrodynamic separator
- UTSA Parking Garage
 - Includes a pedestrian bridge and Welcome Center
- Treatment area
 - 0.92- acre area of the garage rooftop



Bartlett Cocke General Contractors

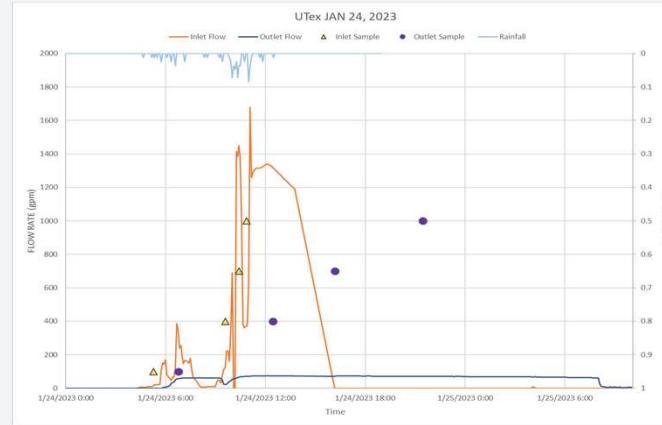
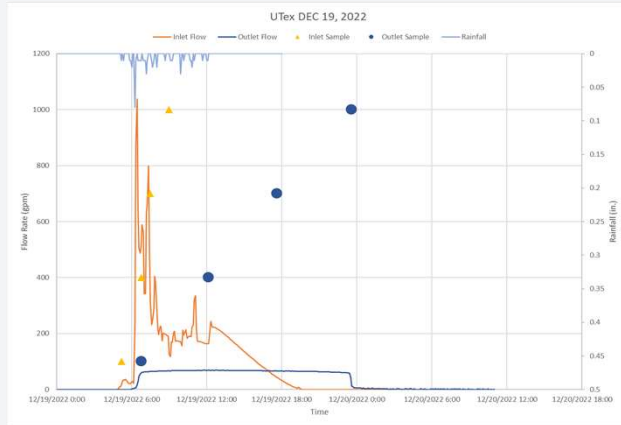
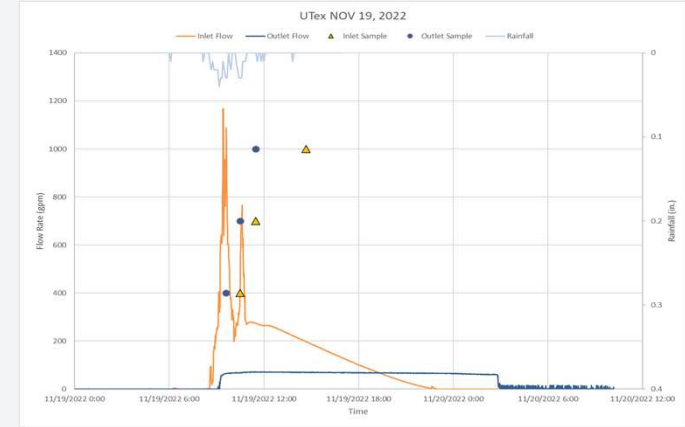
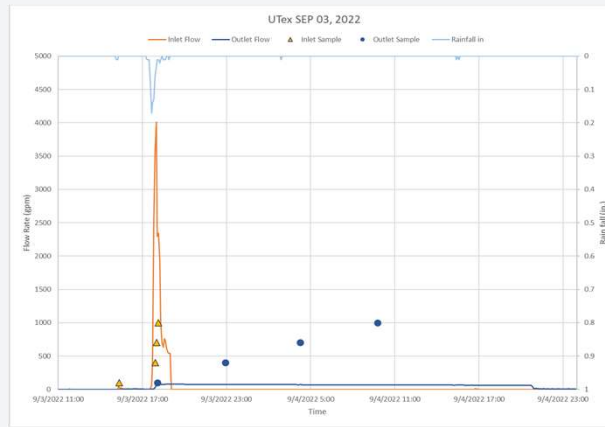
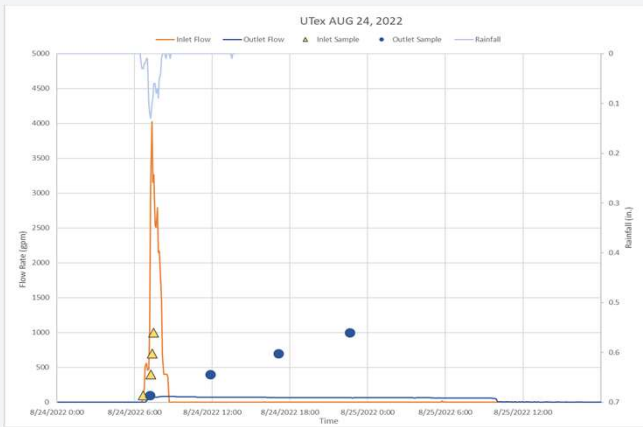


Jellyfish- UTSA Resident 5 Lot

- Jellyfish Filter – Overdue for maintenance
- Surface lot located on the UTSA campus
- Treatment area
 - 1.83-acre drainage area



Hydrographs - Sand Filter Basin: Pre-maintenance



Sand Filter Water Quality

Inlet & Outlet EMC statistically different

UTEX Sand Filter Basin	Mean Inlet EMC (mg/L)	Inlet SD	Mean Outlet EMC (mg/L)	Outlet SD	p-value ($\alpha=0.05$) (based on paired t test)	Removal Efficiency (%)
TSS	108	69.6	5.55	2.93	0.0275	94.9
VSS	20.6	13.6	1.54	1.67	0.0257	92.5
Total Nitrogen	1.68	0.782	1.13	0.893	0.265	
Dissolved Nitrogen	0.766	0.677	1.32	0.357	0.352	
Total Phosphorus	0.480	0.165	0.347	0.080	0.215	
Dissolved Phosphorus	0.289	0.112	0.351	0.0938	0.188	
Total Copper	10.1	3.44	7.17	2.91	0.157	
Total Nickel	4.67	1.50	2.78	0.193	0.0342	40.5
Total Lead	2.71	1.49	0.100	0.0683	0.0163	96.3
Total Zinc	67.0	33.8	22.8	8.26	0.0560	
Dissolved Copper	6.20	4.28	6.32	4.08	0.907	
Dissolved Nickel	2.48	0.306	2.53	0.201	0.770	
Dissolved Lead	0.0307	0.0687	0.000128	0.000287	0.348	
Dissolved Zinc	14.5	13.6	5.10	6.88	0.148	
Oil & Grease	9.34	13.1	6.15	8.91	0.291	
TOC	6.00	1.76	4.72	1.54	0.0820	
	Mean Inlet EMC (MPN/100ml)	Inlet SD	Mean Outlet EMC (MPN/100ml)	Outlet SD	p-value ($\alpha=0.05$) (based on paired t test)	
Total coliform	1.98×10^4	7.48×10^3	1.60×10^4	8.58×10^3	0.302	
E. coli	5.00×10^3	4.14×10^3	2.73×10^3	2.96×10^3	0.192	

Slide 13

DJ10 This is good but maybe use color coding and be ready to explain where outlets were less than inlets, and where no differences, and where inlets were less than outlets.

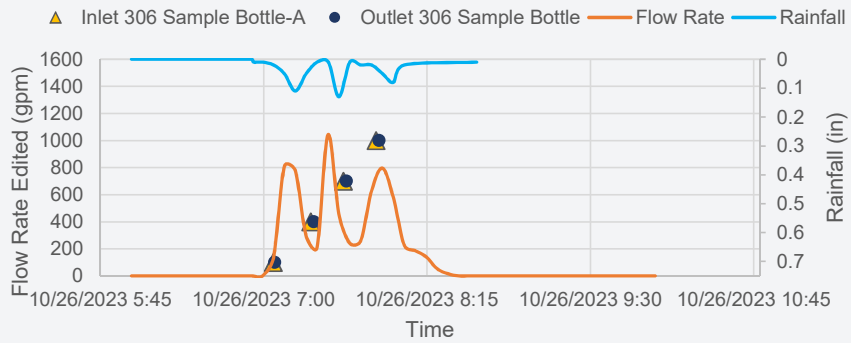
Drew Johnson, 7/10/2023

FE7 done

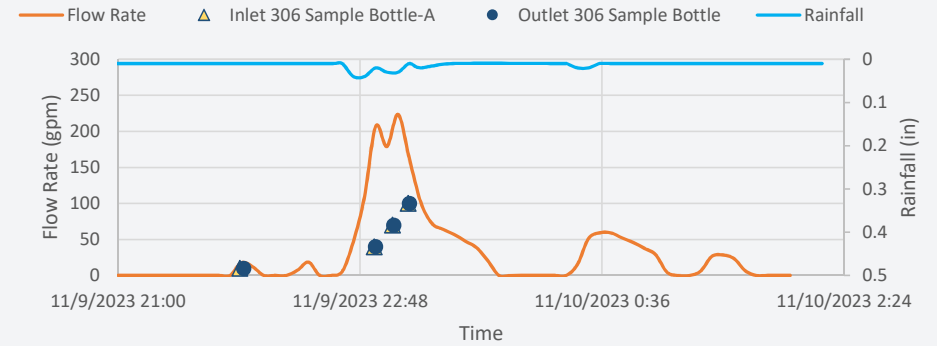
Felicia Ellis, 7/17/2023

Hydrographs - Jellyfish: Pre-maintenance

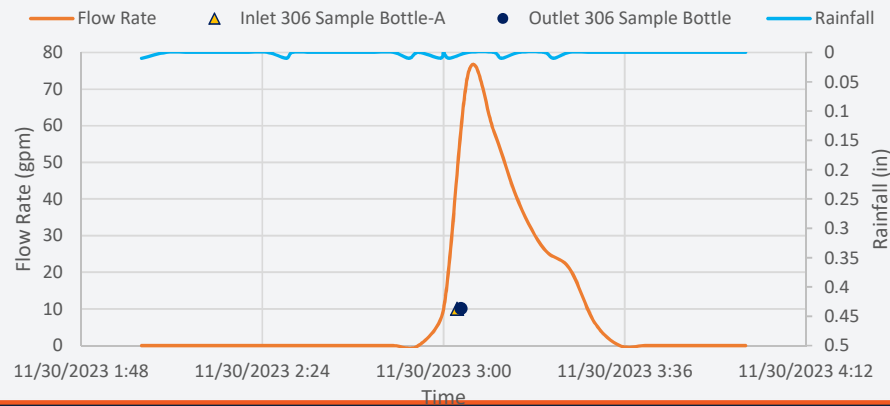
Jellyfish 10/26/2023



Jellyfish 11/09/2023



Jellyfish 11/30/2023



Inlet & Outlet EMC statistically different

Jellyfish Filter	Mean Inlet EMC (mg/L)	Inlet SD	Mean Outlet EMC (mg/L)	Outlet SD	p-value (α=0.05) (based on paired t test)
TSS	43.7	17.5	32.7	23.2	0.654
VSS	10.6	3.93	6.16	3.92	0.322
Total Nitrogen	0.674	0.753	1.50	1.68	0.489
Dissolved Nitrogen	0.932	1.31	1.92	0.986	0.352
Total Phosphorus	0.196	0.177	0.173	0.145	0.524
Dissolved Phosphorus	0.315	0.0696	0.353	0.128	0.439
Total Copper					
Total Nickel					
Total Lead					
Total Zinc					
Dissolved Copper					
Dissolved Nickel					
Dissolved Lead					
Dissolved Zinc					
Oil & Grease	0.0129	0.0223	0.00416	0.00720	0.423
TOC					
	Mean Inlet EMC (MPN/100ml)	Inlet SD	Mean Outlet EMC (MPN/100ml)	Outlet SD	p-value (α=0.05) (based on paired t test)
Total coliform	7.65x10 ³	3.25x10 ³	7.84x10 ³	1.70x10 ³	0.945
E. coli	5.01x10 ³	4.14x10 ³	2.73x10 ³	2.96x10 ³	0.192

Preliminary Observations to Date

- Sand filter basin continued to meet solids removal efficiency (89%) over the pre-maintenance monitoring period
- Compliance issues found in 60% of BMPs in database
 - Vegetative overgrowth
 - Sediment buildup

Future Work

- Complete pre- and post-maintenance water quality monitoring for Vortechs and Jellyfish Filter
- Complete post-maintenance water quality monitoring for sand filter basin once maintenance is performed
- Life Cycle Analysis

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City of San Antonio- Edwards Aquifer Protection Venue Project
A voter-approved watershed and preservation initiative



Thank You

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