Cottage Grove Subdivision Low Impact Development Demonstration Project Final Report

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Cottage Grove Subdivision Low Impact Development Demonstration Project

Introduction

Cottage Grove is a subdivision located in the highly urbanized watershed of White Oak Bayou in the northwest side of Houston as shown in Figure 1. Currently, high levels of bacteria, nutrients and sediment enter White Oak Bayou throughout the watershed, and ultimately discharge into Galveston Bay. The City of Houston selected Cottage Grove as the location of a low impact development (LID) pilot project as an attempt to improve the quality of stormwater runoff in the subdivision which contributes to flows entering White Oak Bayou. LID is an integrated approach for managing storm water quality and quantity through the on-site storage and filtration of runoff. Cottage Grove is currently being redeveloped from low density single family homes to high density townhomes, significantly increasing the imperviousness of each lot from 50 percent to 90 percent. With this increased imperviousness, a related increase of storm water runoff and pollutant loading flows into White Oak Bayou during storm events. To combat the increase in quantity and pollutant loading of stormwater runoff, LID features were installed in a two-block section of Darling Street, as shown in Figure 2, within the subdivision. Ultimately, this pilot project was designed to evaluate the ability of LID features to improve the quality of stormwater runoff leaving the Cottage Grove Subdivision and discharging into White Oak Bayou.

The LID site is situated on two blocks of Darling Street, between T.C. Jester and Reinerman Street. The runoff from Darling Street drains to T.C. Jester Boulevard, Detering Street, and Reinerman Street, with the high points near the middle of Darling Street. There are currently three types of LID features on both sides of the street including rain gardens, tree boxes and a combination of rain gardens and tree boxes. Figure 3 shows the location of the LID features and outlet sampling locations. The goal of this pilot project is to collect four storms and evaluate the effectiveness based on water quality improvement of the LID features. The project kicked off in 2011 and was delayed for more than 2 years due to construction issues; however, in 2015, samples were taken for 4 storms and are summarized in this report.

Figure 1
Vicinity Map

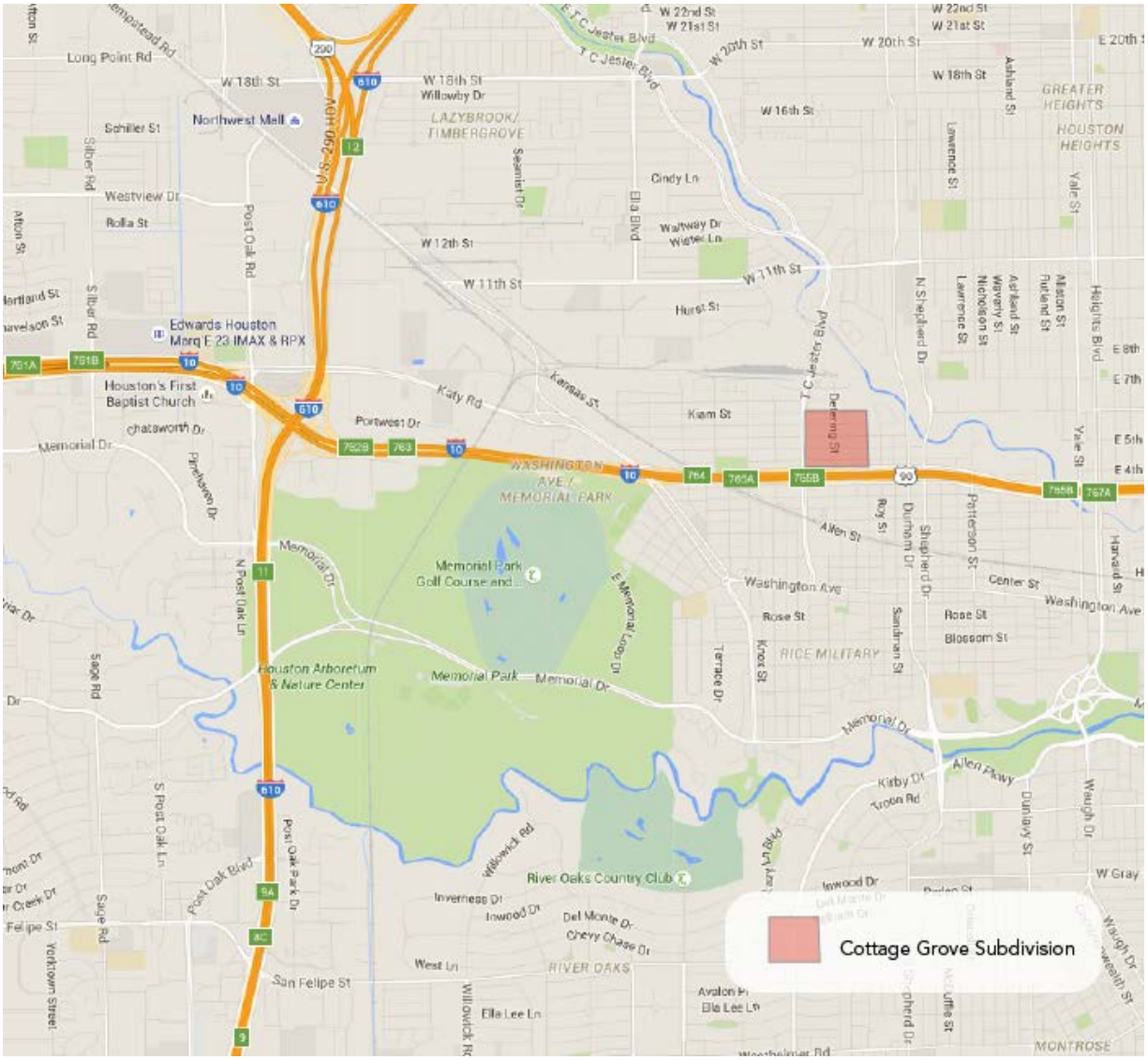
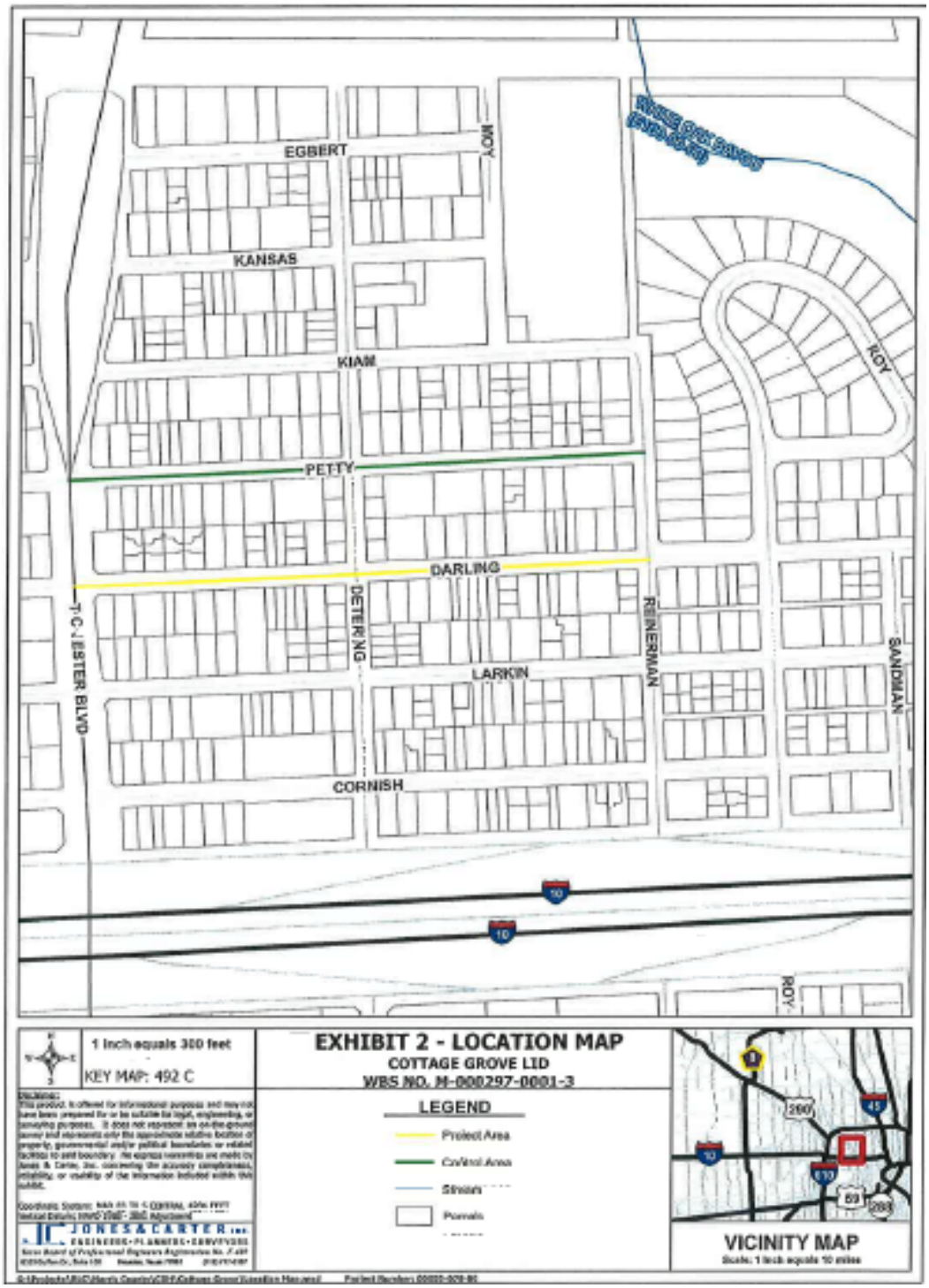


Figure 2
Location map



(Source: Preliminary Engineering Report White Oak Bayou Cottage Grove Subdivision Low Impact Development Demonstration Project)

Figure 3
Cottage Grove LID site feature locations

Tree Boxes
Rain Garden
Outlet
Street high point

Methodology

This project was designed to demonstrate the effectiveness of low impact development (LID) technologies at removing nutrients, bacteria and total suspended solids (TSS) from stormwater runoff. The LID technologies at the site, including rain gardens and tree boxes, allow for stormwater to collect and infiltrate through the soil to an underground storage area prior to reaching the storm sewers.

The collection of the samples coincides with the start of a rainfall event, and continues at regular intervals throughout the runoff event. For a rainfall event to be sampled, the storm must produce at least 0.1 inches of rain in order to collect representative samples throughout the event. If multiple storms are to be sampled, events cannot be collected within 24 hours of a measurable rainfall event (greater than 0.1 inches). For each rainfall event, both inflow and outflow grab samples were taken at specified LID features to evaluate the effectiveness of the features. In addition to grab samples, the velocities of outflows were taken at the same LID features. Samples were taken from the start of the rainfall until the flow was no longer measurable, at regularly spaced intervals (approximately 30 minutes). The following section explains the field sampling procedure in more detail.

Field Sampling Procedure

Grab samples were collected following the conventional and microbiological parameters outlines in the TCEQ Surface Water Quality Monitoring Procedure Manual. At each sampling location, three 450 mL samples and one 100 mL bacteria sample were collected. Table 1 shows the specific requirements for

each sample; the table was derived from the City of Houston's Department of Public Works and Engineering Quality Assurance Project Plan. Samples were collected from west to east; the north side of the street was sampled for Events 1 and 2, where the south side of the street was sampled for Events 3 and 4. On-site measurements were taken at the outlets at all of the LID sites using an YSI 650 MDS. The 650 MDS measures dissolved oxygen, turbidity, conductivity, pH, and temperature. Prior to sampling, the 650 MDS was calibrated specifically for pH and conductivity. The velocity of outflows was found using an automated flow meter, made by Swissmade Flowatch, whenever adequate flow was present.

The grab samples are labeled by site number, site description and grab number, and then placed in an ice chest. After the event ended, the samples were taken to the City of Houston's water quality laboratory within the holding time period. The samples were analyzed at the lab, and the results are sent back to the sampling team.

Table 1
BMP Effectiveness Monitoring*

Parameter	Matrix	Sample Type	Container**	Preservation	Minimum Sample Volume	Holding Time
Nitrite +Nitrate-N	Water	Grab	250 ml Polyethylene Bottle	Ice, dark	250 mL	28 days
Total Phosphorus-P	Water	Grab	250 ml Polyethylene Bottle	Ice, dark, pH<2 with H_2SO_4	250 mL	28 days
E. coli	Water	Grab	100 ml Polyethylene Bottle	Ice, 0.008% $Na_2S_2O_3$	100 mL, Sterilized Bottle	6 hours**
Total Suspended Solids	Water	Grab	250 ml Polyethylene Bottle	Ice, dark	250 mL	7 days

*The BMP Effectiveness Monitoring is from White Oak Bayou BMP Demonstration Project within the Cottage Grove Subdivision Quality Assurance Project Plan.
**The six hour holding time will be followed when all possible, but in case of infrequent rain events and necessary samples of E. coli are collected late in the evening or on weekends, the 24 hour holding time used by the City of Houston's Water Quality Laboratory at 2300 Federal Road may be followed.

Results

As of December 2015, four runoff events have been sampled. The dates of these four storm events can be found in Table 2 below. Of the four storms that have been sampled, only one showed a decrease in pollutants in the outflow.

Table 2
Sampled Rainfall Events

Event	Date
Event #1	April 10, 2015
Event #2	April 14, 2015
Event #3	June 30, 2015
Event #4	November 17, 2015

Sampling Event 2

Event 2 took place on April 14th, 2015; the total rainfall was 0.16 inches. Figures 4 - 7 show the average concentration of the pollutants at the inflow and outflow of Event 2 for each LID feature. The outflow from tree boxes and the combination of tree boxes and rain gardens showed an increase in nitrate concentration; however, the rain gardens alone showed a decrease in nitrate concentration (Figure 4). Nitrate levels could have increased due to the microbial activity in the soil through the process of nitrification. In all three LID features, the concentration of total phosphorus increased (Figure 5). TSS decreased between 50% and 95% in all three LID features (Figure 6). The concentration of E. coli remained constant in two of the three features, and increased in the third (Figure 7).

Figure 4
Average Nitrate Concentration of Inflows and Outflows for Event 2 (April 14, 2015)

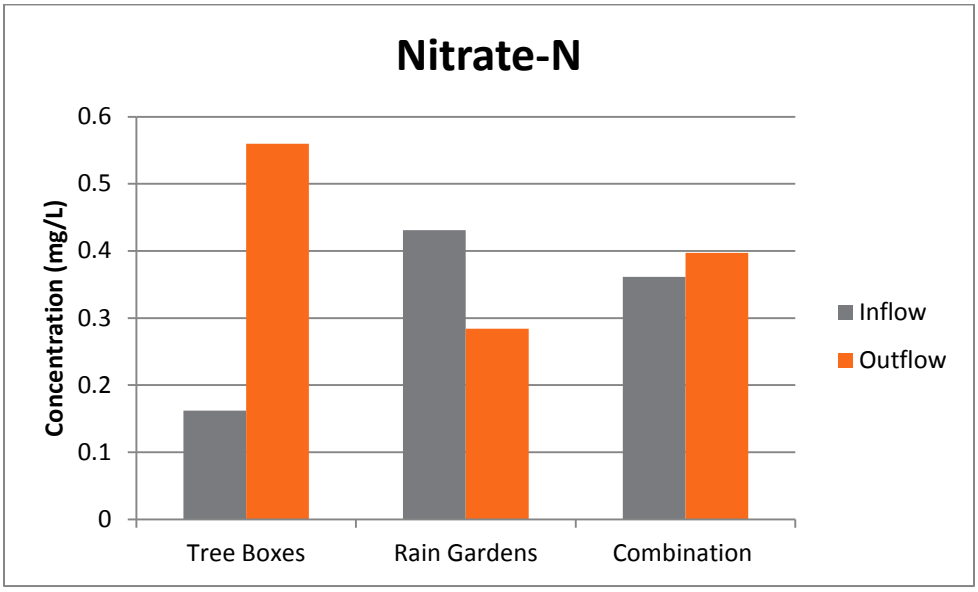


Figure 5
Average Total Phosphorus Concentration of Inflows and Outflows for Event 2 (April 14, 2015)

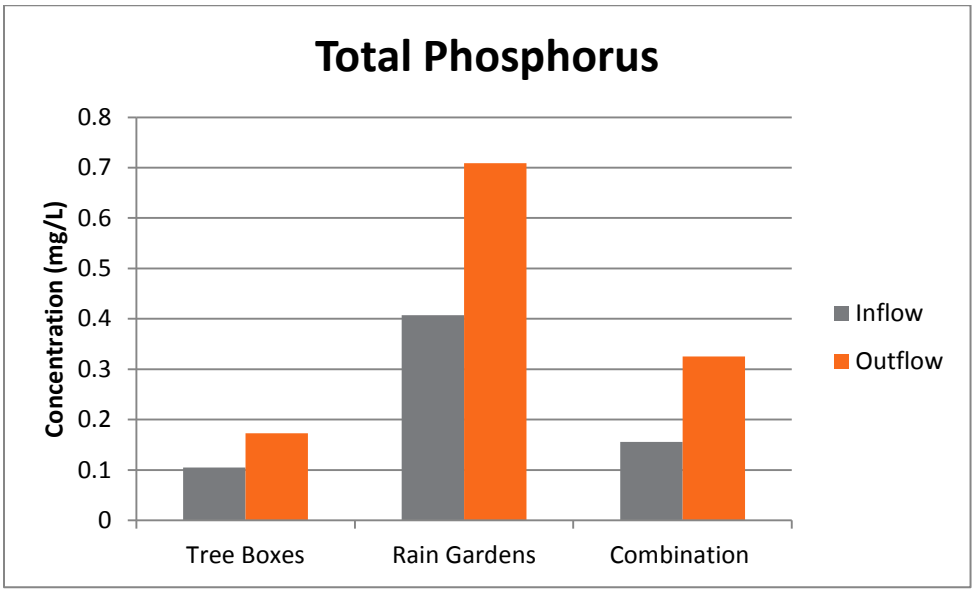


Figure 6
Average Total Suspended Solids (TSS) Concentration of Inflows and Outflows for Event 2 (April 14, 2015)

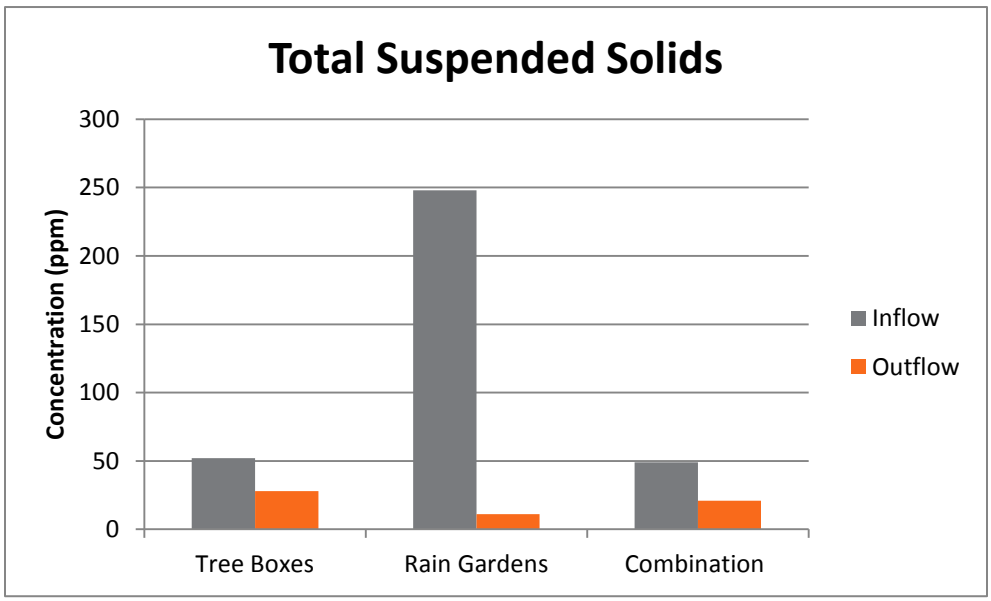
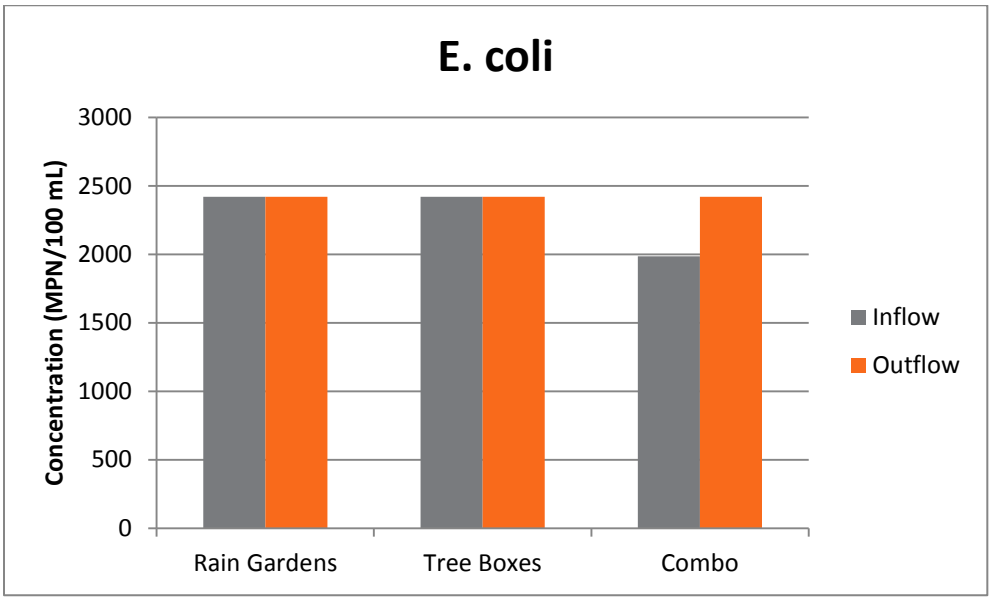


Figure 7
Average E.coli Concentration of Inflows and Outflows for Event 2 (April 14, 15)



Sampling Event 3

Sampling Event 3 was collected on June 30th, 2015. The total precipitation that fell was 0.52 inches. Figures 8 - 11 show the average concentration of nitrate-N, total phosphorus, total suspended solids (TSS), and E. coli in the inflow and outflow for each of the LID features, respectively. During Event 3, there was no outflow from the tree boxes; therefore, a comparison could not be made. For all four pollutants, there was a dramatic decrease in concentration in the outflow, except for a slight increase in total phosphorus in the combination of tree boxes and rain gardens (Figure 9). This increase could be due to cross contamination, explained in more detail in the following section. TSS and E.coli found in Figure 10 and Figure 11 had the greatest reduction in concentration of approximately 97% and 92%, respectively, from the rain garden.

Figure 8
Average Nitrate Concentration of Inflows and Outflows for Event 3 (June 30, 2015)

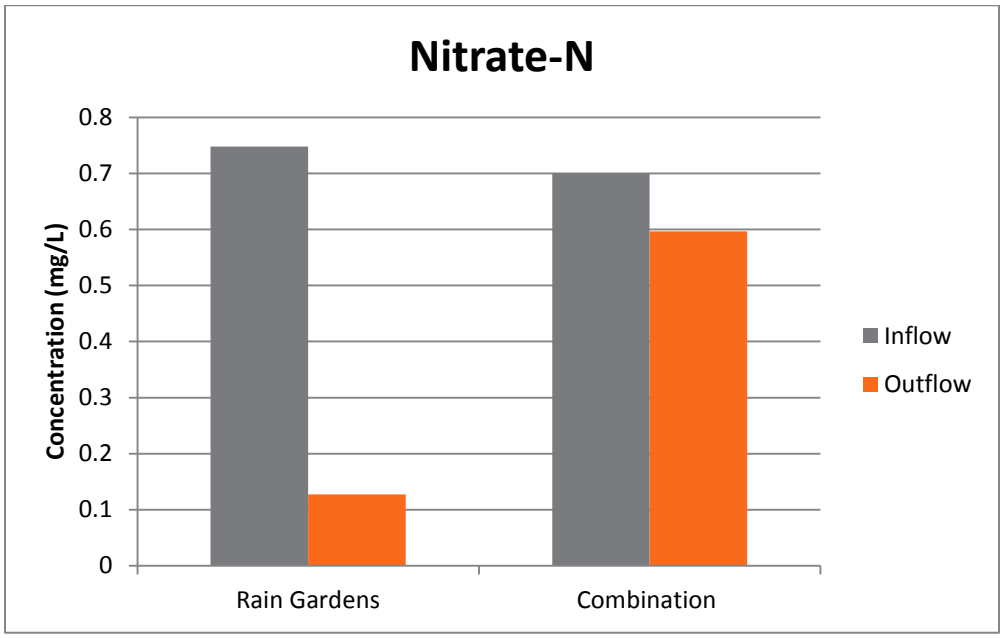


Figure 9
Average Total Phosphorus Concentration of Inflows and Outflows for Event 3 (June 30, 2015)

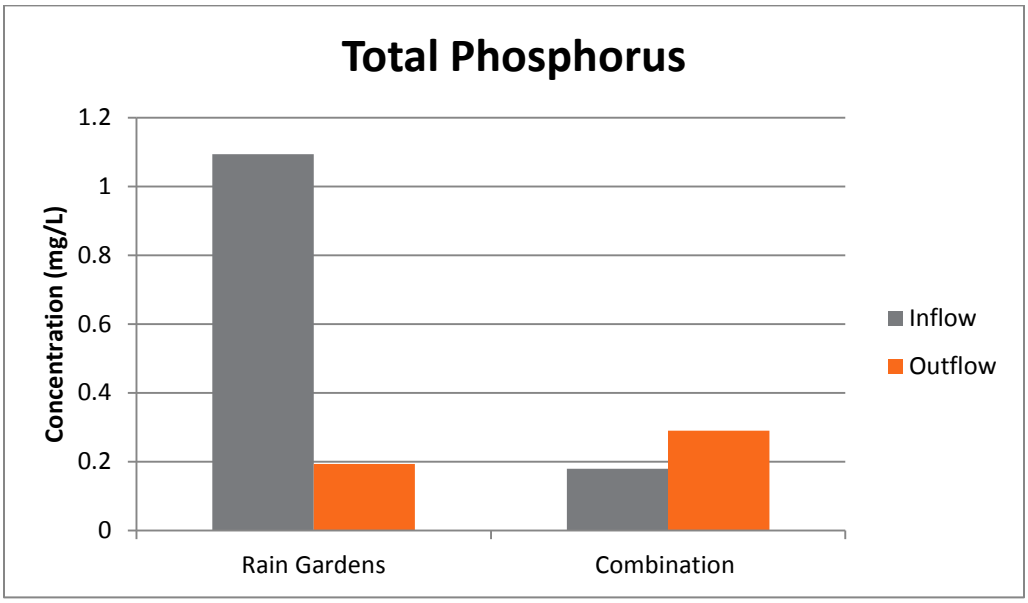


Figure 10
Average Total Suspended Solids (TSS) Concentration of Inflows and Outflows for Event 3 (June 30, 2015)

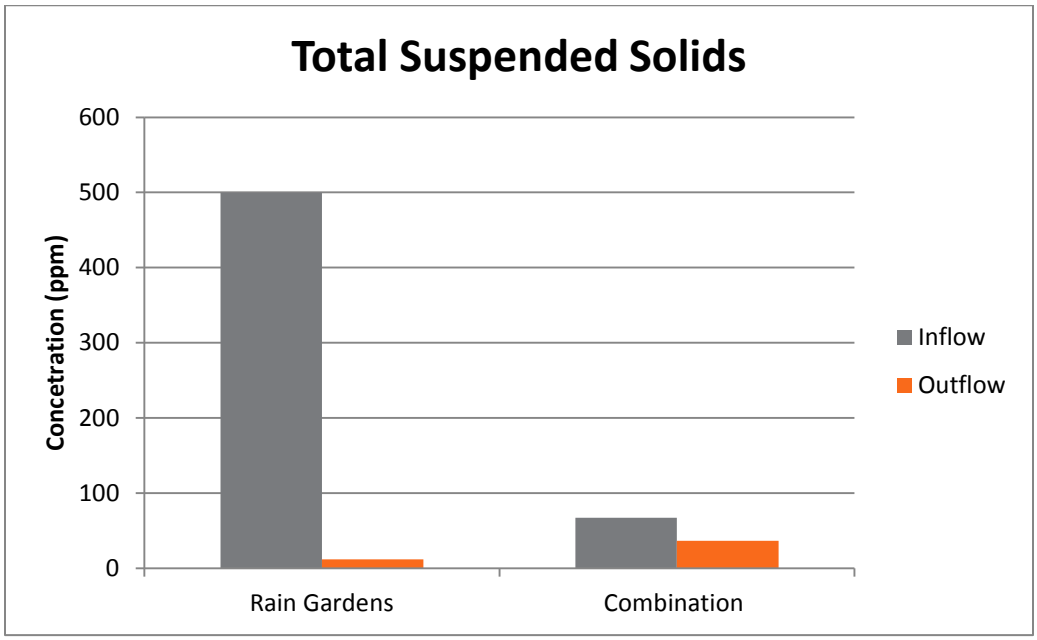
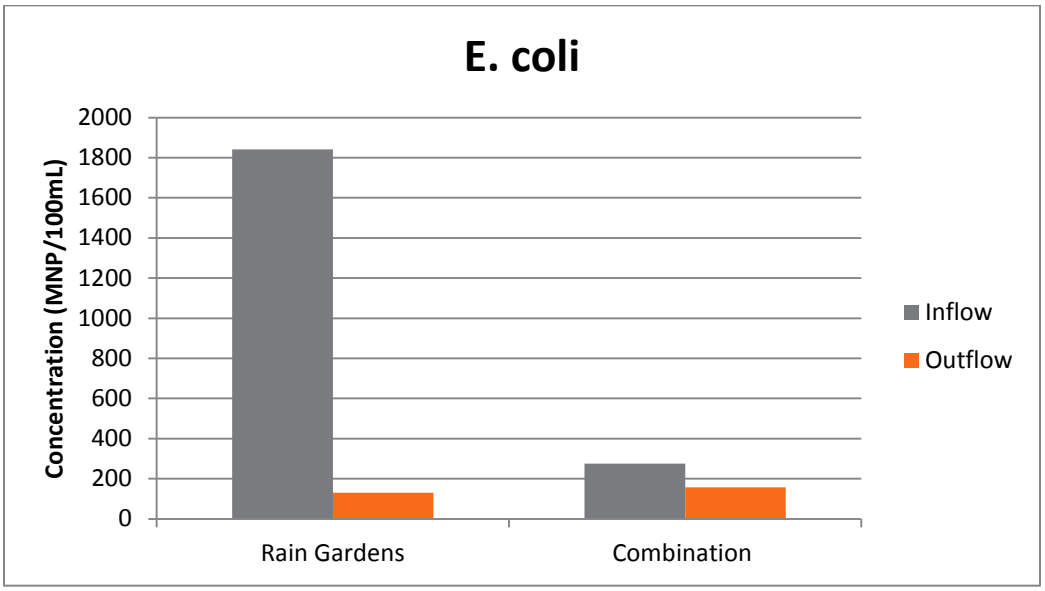


Figure 11
Average E.coli Concentration of Inflows and Outflows for Event 3 (June 30, 2015)



Possible Result Errors

One potential source for error in the results could be due to cross contamination. At some of the outflow stations, the outflow pipes of the LID features are in close proximity to other drainage outflows

that are unrelated to the LID feature. While caution was used in obtaining grab samples from all outflow stations, errors in sampling results could have occurred from cross contamination of unfiltered storm water. Another source of error could be due to the sampling techniques used to obtain the sample. For example, when outflow is low which was often the case during the observed storm events, it was difficult to grab enough water to fill all the sample bottles without grabbing some water from the bottom of the manhole; the water at the bottom of the manhole tends to have increased sediment accumulation and could contribute to the increase in pollutants seen in the outflow.

Another potential source for error in the results could be due to observing storms that produced too little runoff, and therefore, outflow from the LID features. Table 3 below includes the average flow rate for the LID features that were captured for Events 1 and 2; Events 3 and 4 did not produce enough measurable flow. The current threshold for a measurable rainfall event is 0.1 inches of rain; however, this rainfall does not always produce adequate runoff for measureable flow at the outflow locations. The limited runoff observed may have swayed the results because inflows and outflows from the LID features are not able to be sampled at the same time. An improvement to be made to the field sampling procedure is expanding the threshold of observed storm events to include storms that produce between 0.2 to 0.4 inches of rain. This size of storm event would likely result in more measurable results due to the increased likelihood of yielding more consistent runoff for inflow and outflow samples.

Table 3
Average Sampled Flow Velocities at Outflow Locations

Event	Rain Garden Flow Velocity (ft./s)	Tree Box Flow Velocity (ft./s)	Combination Flow Velocity (ft./s)
Event #1	0.9	0.6	2.3
Event #2	0.9	0.7	1.3
Event #3	-	-	-
Event #4	-	-	-

Lastly, the lab was not specific in reporting E. coli levels. This resulted in a limited understanding of the performance of the LID features with respect to reducing E. coli levels, as the E. coli measurements were not very accurate. For instance, the upper detection limit of E. coli is 2419.6 MPN/100mL, which may not have been a high enough detection limit to fully capture a change in E. coli concentrations occurring within inflow and outflow samples. It is possible that a reduction in E. coli may have occurred as a result

of the LID features, yet the E. coli levels may have been so high that any reduction in those levels is not being represented by the data analysis.

Conclusion

The Cottage Grove Subdivision was selected as the location of a low impact development (LID) pilot project for the City of Houston as a way to test the efficacy of LID techniques in improving water quality of White Oak Bayou. LID is an integrated approach for storm water management and water quality improvements that focuses on storage and infiltration of runoff. The goal of this demonstration project was to analyze the effectiveness of LID features to improve water quality and reduce peak volume of storm water runoff entering the White Oak Bayou. The outcome of the four observed events showed mixed results; some of the outflow pollutant concentration increased, while others decreased. It can be seen from Sampling Event 3 that LID features have the ability to greatly affect the quality of storm water runoff. Maintenance of the LID features also plays a role in optimal performance; in order to get the best results from an LID feature, it is important to maintain the site by removing large pieces of garbage and other debris.

Overall, the results of this study display inconsistency regarding the performance of LID to effectively reduce pollutant load within stormwater runoff. This finding has also been observed in other independent LID studies conducted by the TCEQ. The results of this research suggest that LID may not be the most effective tool for the consistent improvement in the quality of stormwater runoff. Conversely, LID features may be better utilized as an effective tool for managing the quantity of stormwater runoff. Used in this capacity, LID features could play an important role in reducing flood risk in many of the highly urbanized neighborhoods within Greater Houston, such as Cottage Grove. Ultimately, the effectiveness of LID features in reducing stormwater runoff was not measured in this research; however, future work on the LID features in the Cottage Grove Subdivision could be focused on measuring the quantity of stormwater runoff reduction during moderate (0.2-0.4 inch) rainfall events.

References

City of Houston, Department of Public Works and Engineering. (2013). White Oak Bayou BMP Demonstration Project- Cottage Grove Subdivision Quality Assurance Project Plan.

Davis, A., Shokouhian, M., Sharama, H., Minami, C., & Winogradoff, D. (2003). Water Quality Improvement thrpugh Bioretention: Lead, Copper, and Zinc Removal. *Water Environment Research*, 73-82. Retrieved from http://www.jstor.org/stable/pdf/25045664.pdf?acceptTC=true

Jones & Carter, Inc. (2012). *Preliminary Engineering Report White Oak Bayou Cottage Grove Subdivision Low Impact Development Demonstration Project.* Houston, TX.

Appendix A – Results of Sampling Events 1 and 4

Sampling Event 1

Sampling Event 1 occurred on April 10, 2015. The total precipitation for this event was 0.55 inches. Figures 12-15 show the average concentration of each pollutant at the inflow and outflow. The average concentrations of nitrate and E. coli had a higher concentration in the outflow as compared with the inflow concentrations. Total phosphorus concentrations decreased in the outflow of the combination of rain gardens and tree boxes, but increased in the features individually. The results show a large decrease in total suspended solid concentrations in rain gardens and tree boxes individually, with a slight increase through the combination of the features.

Figure 12
Average Nitrate Concentration of Inflows and Outflows for Event 1 (April 10, 2015)

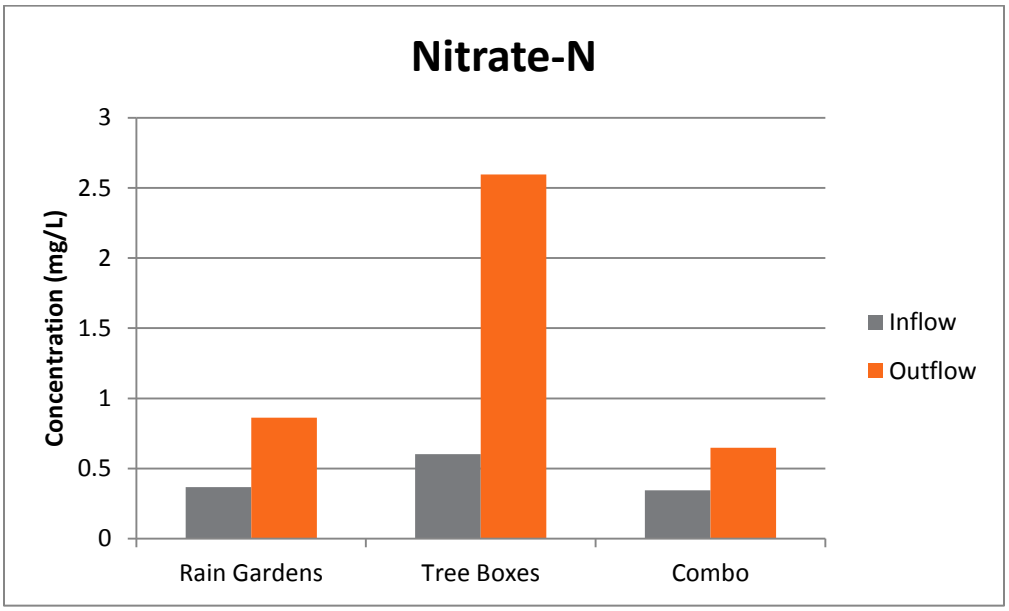


Figure 13
Average Total Phosphorus Concentration of Inflows and Outflows for Event 1 (April 10, 2015)

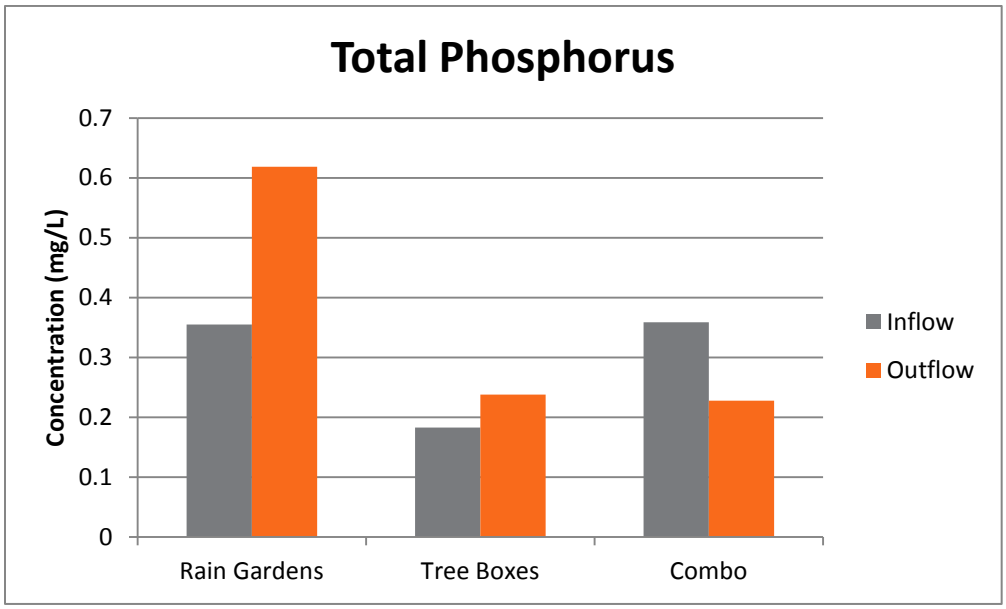


Figure 14
Average Total Suspended Solids (TSS) Concentration of Inflows and Outflows for Event 1 (April 10, 2015)

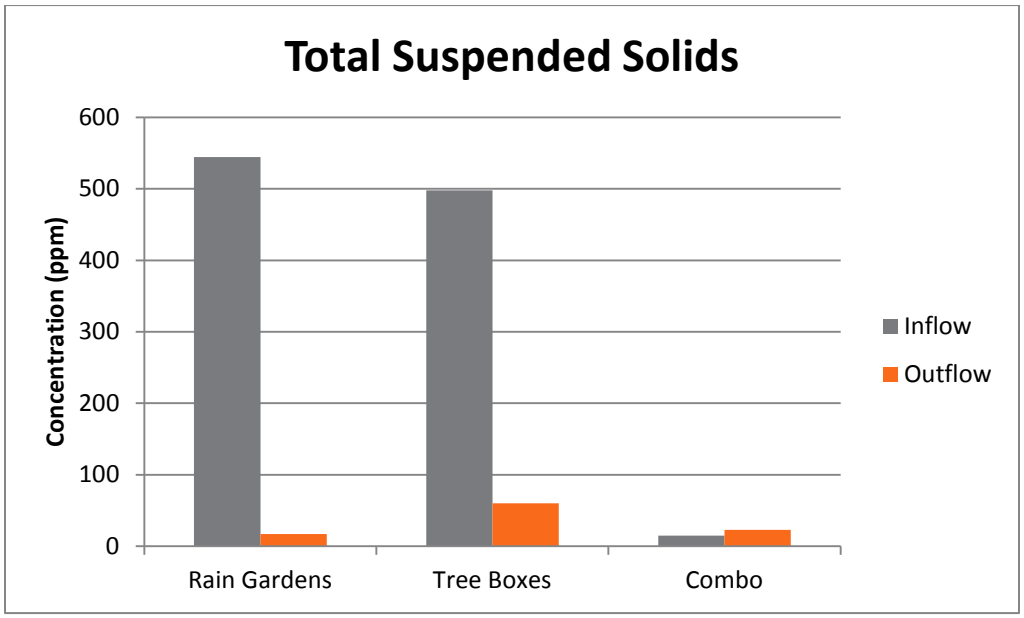
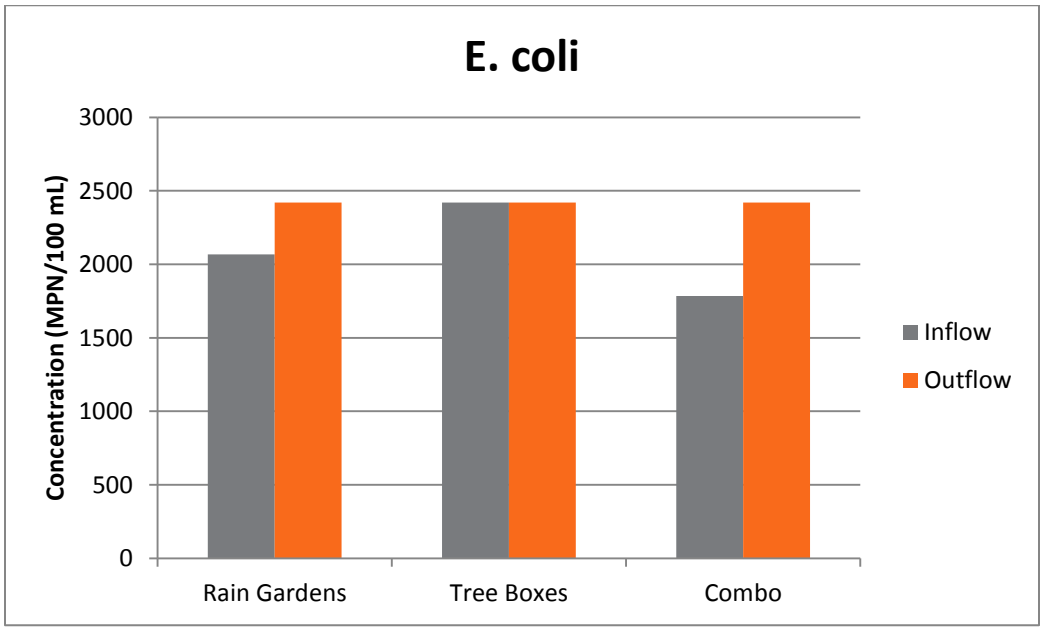


Figure 15
Average E.coli Concentration of Inflows and Outflows for Event 1 (April 10, 2015)



Sampling Event 4

Sampling Event 4 was sampled on November 17, 2015. The total precipitation for this event was roughly 1.4 inches. Figures 16-19 show the average concentration of nitrate-N, total phosphorus, total suspended solids (TSS), and E. coli in the inflow and outflow for each of the LID features, respectively. Both the rain gardens and tree boxes, respectively, had higher concentrations of nitrate in the outflow compared to the inflow, whereas the outflow of the combination of tree boxes and rain gardens showed a reduction in nitrate concentration (Figure 16). Total phosphorus concentrations decreased in the outflow for the tree boxes; however, the outflow for the individual rain gardens and the combined LID features showed an increase in total phosphorus concentration (Figure 17). For all three LID features, the outflow concentration of TSS decreased (Figure 18). Lastly, E. coli concentrations decreased in the outflow of the individual rain gardens and tree boxes; however, increased E. coli concentration was measured in the outflow of the combined LID feature (Figure 19). Overall, Sampling Event #4 showed an underwhelming performance of the LID features in improving the quality of stormwater runoff. Outside of positive reductions in TSS and E. coli, the LID features in this sampling event were not effective in lowering the concentrations of nitrate and total phosphorus in the outflows.

Figure 16
Average Nitrate Concentration of Inflows and Outflows for Event 4 (November 17, 2015)

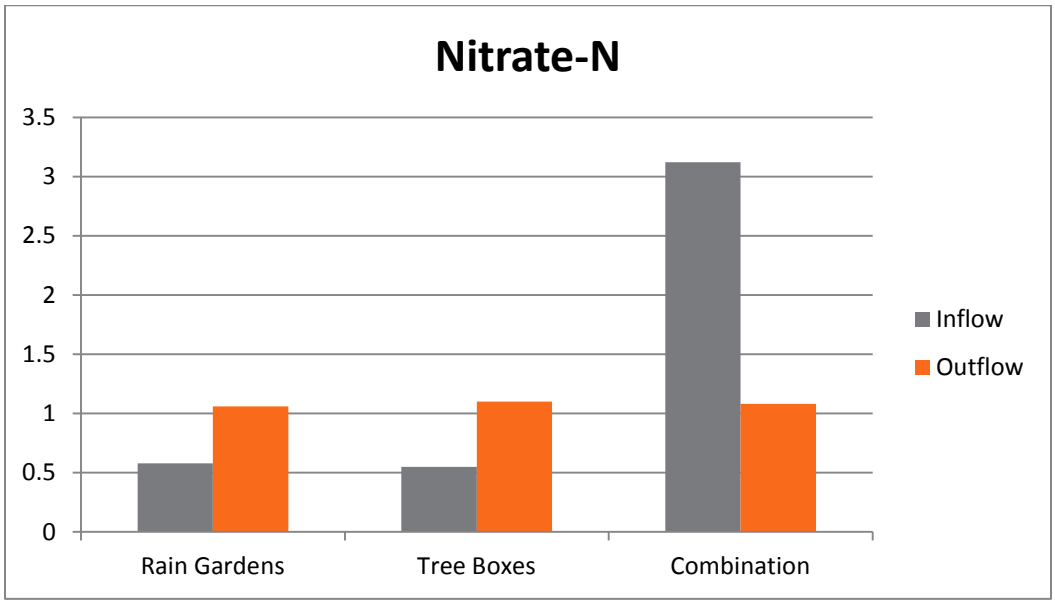


Figure 17
Average Total Phosphorus Concentration of Inflows and Outflows for Event 4 (November 17, 2015)

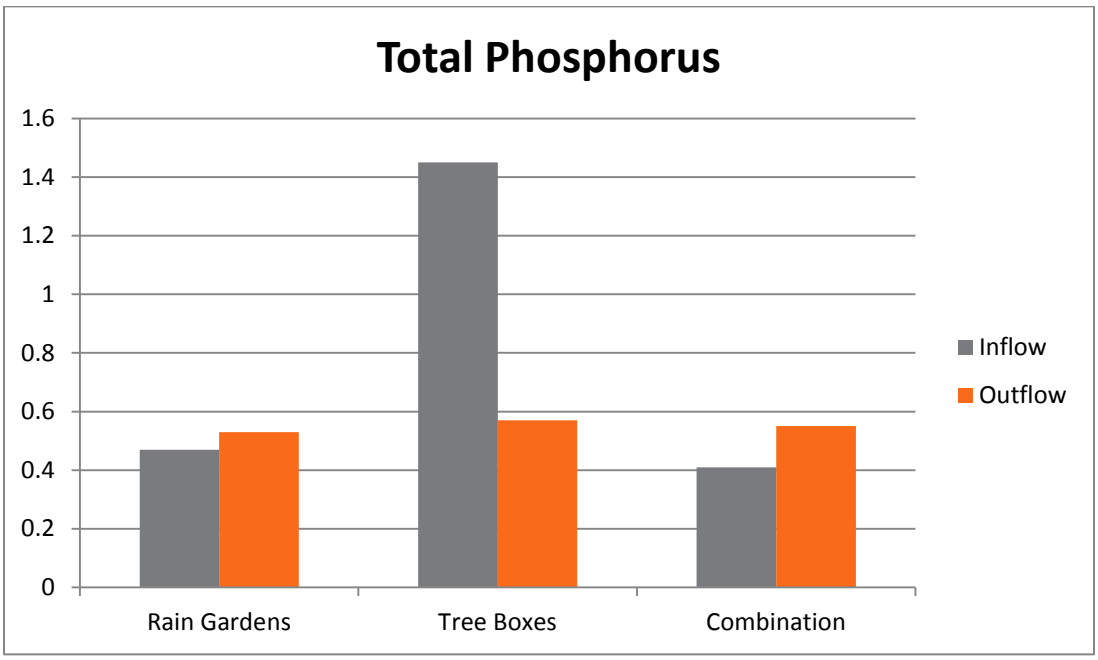


Figure 18
Average Total Suspended Solids (TSS) Concentration of Inflows and Outflows for Event 4 (November 17, 2015)

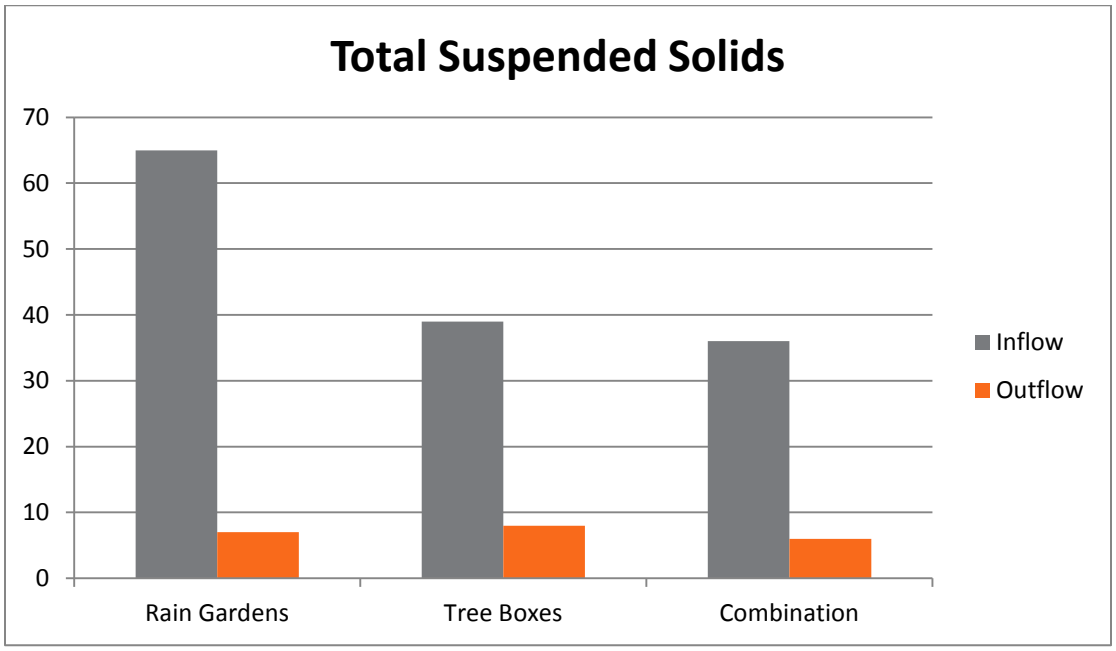
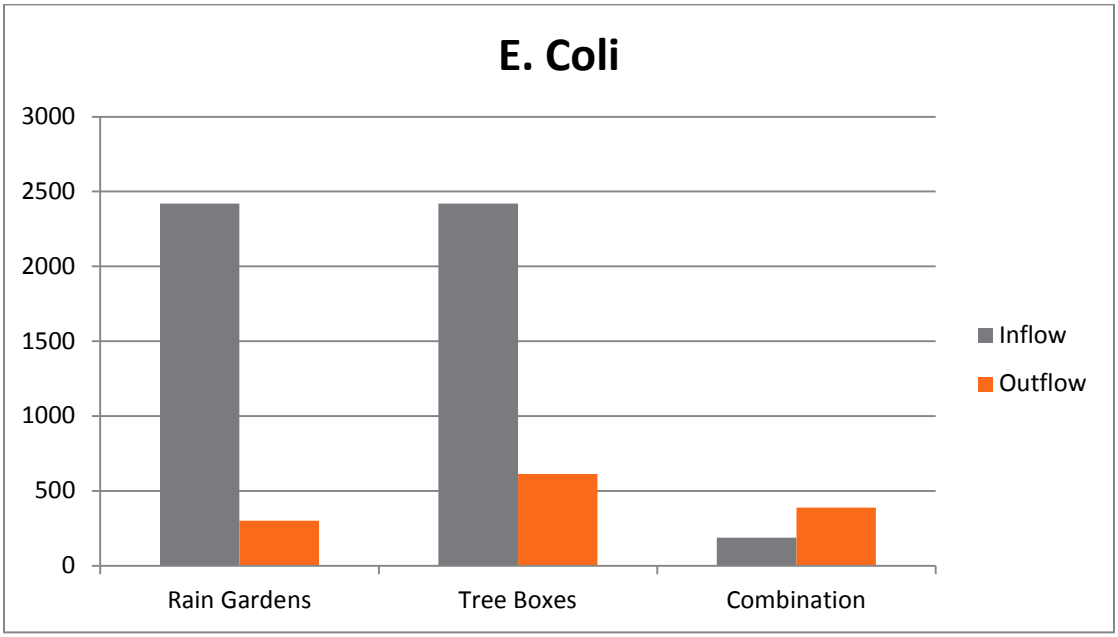


Figure 19
Average E. Coli Concentration of Inflows and Outflows for Event 4 (November 17, 2015)



Appendix B – Sampling Chain of Custody Forms

Courtney Hale
5128645788
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cthg@rice.edu

Water Quality Laboratory
2300 Federal Road, Houston, Tx.77015
713-330-2501
Chain of Custody (Special Project)

Effective	Applied Area	Document Type	Document ID	Version	Document Page
01/01/08	*Laboratory*	*Form*	*144*	*1.01*	1 of 2

Lab Use Only	Item	Sample ID /Description	Sampling Date	Sampling Time	Depth(s) (ft)	Sample Type Comp.	Sample Type Grab	Matrix Water	Matrix Soil	Matrix Other	No. Of Containers	Type of Container/ Preservation	Requested Analysis: E. coli	NO_2/NO_3	NH_3	Ortho-P	Total-P	TSS
		~~CG01TBT~~										3PG, 1 $Na_2S_2O_3$ Bac-T						
	1	CG01TB1	4/10/15	2:11 pm	runoff RO		X	X					X	X	X	X	X	X
	2	CG01OUT1	4/10/15	2:11 pm	well		X	X					X	X	X	X	X	X
	3	CG02RG1	4/10/15	2:21	RO		X	X					X	X	X	X	X	X
	4	~~CG02OUT~~ CG03RG1		2:27	RO		X	X					X	X	X	X	X	X
	5	CG04TB1		2:38	RO		X	X					X	X	X	X	X	X
	6	CG04RG1		2:38	RO		X	X					X	X	X	X	X	X
	7	CG04OUT1		2:40	well		X	X					X	X	X	X	X	X
	8	CG01TB2		2:44	RO		X	X					X	X	X	X	X	X
	9	CG01OUT2	4/10/15	2:44	well		X	X					X	X	X	X	X	X

Comments: Storm H_2O Sampling City of Houston - PWE by Rice University [Cheryl Harris]

Collected By: Courtney Hale, Dave Mahoney, Mikaela Mahoney

Relinquished By: Courtney Hale

Received By:

Relinquished Date and Time: 4/10/15 4:21

Received Date & Time: 4/10/15 4:21

Courtney Hale
512-864-5788

Water Quality Laboratory
2300 Federal Road, Houston, Tx.77015
713-330-2501
Chain of Custody (Special Project)

Effective	Applied Area	Document Type	Document ID	Version	Document Page
01/01/08	*Laboratory*	*Form*	*144*	*1.01*	2 of 2

Lab Use Only	Item	Sample ID /Description	Sampling Date	Sampling Time	Depth(s) (ft)	Sample Type Comp.	Sample Type Grab	Matrix Water	Matrix Soil	Matrix Other	No. Of Containers	Type of Container/ Preservation	Requested Analysis E. Coli	NO2/NO3	NH3	Ortho P	Total P	TSS
												3PG, 1 NaS2O3 Batt						
	10	CG02RG2	4/10/15	2:54	RO		X	X					X	X	X	X	X	X
	11	CG02OUT2	4/10/15	2:56	well		X	X					X	X	X	X	X	X
	12	CG03RG2	4/10/15	2:59	RO		X	X					X	X	X	X	X	X
	13	CG03OUT2	4/10/15	2:59	well		X	X					X	X	X	X	X	X
	14	CG04RG2	4/10/15	3:14	RO		X	X					X	X	X	X	X	X
	15	CG04OUT2	4/10/15	3:15	well		X	X					X	X	X	X	X	X

Comments: Courtney Hale / Dave Mahoney / Mikaela Mahoney

Collected By: Courtney Hale

Relinquished By: [signature]

Received By: [signature]

Relinquished Date and Time: 4/10/15 4:21

Received Date & Time: 4/10/15 4:21

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Water Quality Laboratory
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Chain of Custody (Special Project)

Effective	Applied Area	Document Type	Document ID	Version	Document Page
01/01/08	*Laboratory*	*Form*	*144*	*1.01*	*1 of 1*

Lab Use Only	Item	Sample ID /Description	Sampling Date	Sampling Time	Depth(s) (ft)	Sample Type Comp.	Sample Type Grab	Matrix Water	Matrix Soil	Matrix Other	No. Of Containers	Type of Container/ Preservation	E. coli (MPN)	NO_2/NO_3	~~NH_3~~	~~Ortho P~~	Total-P	TSS	
												3PB, 1 $Na_2S_2O_3$ Bact							
	1	CG02RG1	4/14/15	10:51 AM			X	X					X	X	X	X	X	X	
	2	CG03RG1	4/14/15	10:59 AM			X	X					X	X	X	X	X	X	
	3	CG04RG1	4/14/15	11:03 AM			X	X					X	X	X	X	X	X	
	4	CG04TB1	4/14/15	11:07			X	X					X	X	X	X	X	X	
	5	~~CG04OUT1~~ CG01OUT1	4/14/15	11:22			X	X					X	X	X	X	X	X	
	6	CG01TB1	4.14.15	11:25			X	X					X	X	X	X	X	X	
	7	CG02RG2	4.14.15	11:30			X	X					X	X	X	X	X	X	
	8	CG02OUT2	4.14.15	11:31			X	X					X	X	X	X	X	X	
	9	CG04OUT2	4.14.15	11:43			X	X					X	X	X	X	X	X	

Comments: Storm water sampling - City of Houston - PWE Rice University cottage Grove [Cheryl Harris]

Collected By: Courtney Hale, Dave Manoney

Temp 13.1 - 1.1 - 12.1

Relinquished By: [signature]

Relinquished Date and Time: 4/14/15 1:02 PM

Received By: CB

Received Date & Time: 4-14-15 1:02 pm

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Effective	Applied Area	Document Type	Document ID	Version	Document Page
01/01/08	*Laboratory*	*Form*	*144*	*1.01*	1 *of* 1

Lab Use Only	Item	Sample ID /Description	Sampling		Depth(s) (ft)	Sample Type		Matrix			No. Of Containers	Type of Container/ Preservation	Requested Analysis						
													E. coli	NO2/NO3	Total-P	TSS			
			Date	Time		Comp.	Grab	Water	Soil	Other		3PB, 1 $NA_2S_2O_3$ BACT							
✓	1	CG04OUT1	30 June	2:40			X	X			4		X	X	X	X			
✓	2	CG05RG1		2:52			X	X					X	X	X	X			
✓	3	CG05OUT1		2:52			X	X					X	X	X	X			
✓	4	CG05RG2		3:00			X	X					X	X	X	X			
✓	5	CG06RG1		3:05			X	X					X	X	X	X			
✓	6	CG06OUT1		3:05			X	X					X	X	X	X			
	7	~~CG04RG2~~		~~3:15~~			~~X~~	~~X~~					~~X~~	~~X~~	~~X~~	~~X~~			
✓	8	CG04OUT2		3:17			X	X					X	X	X	X			
✓	9	CG05OUT2		3:20			X	X					X	X	X	X			

Comments: [BACT1: DILUTE 10:1] STORM WATER SAMPLING - CITY OF HOUSTON - COTTAGE GROVE

Collected By: Mahoney DAVID

Relinquished By: Mahoney DAVID

Relinquished Date and Time: 30 June 4:30pm

Received By: MT

Received Date & Time: 6/30/15 @ 4:30 pm.

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Effective	Applied Area	Document Type	Document ID	Version	Document Page
01/01/08	*Laboratory*	*Form*	*144*	*1.01*	1 *of* 1

Lab Use Only	Item	Sample ID /Description	Sampling		Depth(s) (ft)	Sample Type		Matrix			No. Of Containers	Type of Container/ Preservation	Requested Analysis						
			Date	Time		Comp.	Grab	Water	Soil	Other		3PB, 1 $NA_2S_2O_3$ BACT	E. Coli	NO_2/NO_3	Total-P	TSS			
	9	CG05RC3	30 June	3:20			X	X			4		X	X	X	X			
	10	CG06OUT2		3:30			X	X			4		X	X	X	X			

Comments: [BACTI: DILUTE 10:1] STORM WATER SAMPLING - CITY OF HOUSTON - COTTAGE GROVE

Collected By: Mahoney, DAVID

Relinquished By: Mahoney, DAVID

Received By: MT

Relinquished Date and Time: 30 June 4:30pm

Received Date & Time: 6/30/15 @ 4:30pm

1 of 2

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Effective	Applied Area	Document Type	Document ID	Version	Document Page
01/01/08	*Laboratory*	*Form*	*144*	*1.01*	1 of 1

Lab Use Only	Item	Sample ID /Description	Sampling		Depth(s) (ft)	Sample Type		Matrix			No. Of Containers	Type of Container/ Preservation	Requested Analysis						
		[redacted]	Date	Time		Comp.	Grab	Water	Soil	Other			E. coli	NO2/NO3	Total-P	TSS			
	1	LG05OUT1	NOV17	0936			X	X			4		X	X	X	X			
	2	LG07OUT1	NOV17	0941			X	X			4		X	X	X	X			
	3	LG08OUT1	NOV17	0946			X	X			4		X	X	X	X			
	4	LG05OUT2	NOV17	955			X	X			4		X	X	X	X			
	5	LG07OUT2	NOV17	1010			X	X			4		X	X	X	X			
	6	LG08OUT2	NOV17	1015			X	X			4		X	X	X	X			
	7	LG05TB1	NOV17	0936			X	X			4		X	X	X	X			
	8	LG07RG1	NOV17	0941			X	X			4		X	X	X	X			
	9	LG08TB1	NOV17	0946			X	X			4		X	X	X	X			

Comments: [BACTI: DILUTE 10:1] STORM WATER SAMPLING - CITY OF HOUSTON - COTTAGE GROVE

Collected By: DAVE MAHONEY

Relinquished By: [signature]

Received By: C.B

Relinquished Date and Time: NOV 17 1102

Received Date & Time: 11-17-15 11:02

2 of 2

D. Mahoney

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Effective	Applied Area	Document Type	Document ID	Version	Document Page
01/01/08	*Laboratory*	*Form*	*144*	*1.01*	1 of 1

Lab Use Only	Item	Sample ID /Description	Sampling		Depth(s) (ft)	Sample Type		Matrix			No. Of Containers	Type of Container/ Preservation	Requested Analysis						
			Date	Time		Comp.	Grab	Water	Soil	Other			E. Coli	NO2/NO3	Total-P	TSS			
	10	~~G608R61~~																	
	10	G608R61	NOV17	0946			X	X			4		X	X	X	X			

Comments: See page 1

Collected By: D. Mahoney

Relinquished By: D. Mahoney

Received By: CB

Relinquished Date and Time: NOV 17 1102

Received Date & Time: 11-17-05 1102