LANDSCAPE PERFORMANCE SERIES

2016 Case Study Investigation
Middle Blue River Basin Green Solutions Pilot Project
Kansas City, Missouri

Methods Document for Landscape Performance Benefits

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This Methods Document was produced to accompany a *Landscape Performance Series* case study brief on landscapeperformance.org. The Case Study Brief and this Methods Document were produced as part of the Landscape Architecture Foundation's Case Study Investigation program, a unique research collaboration that matches LAF-funded faculty-student research teams with leading practitioners to document the benefits of exemplary high-performing landscape projects.

The Case Study Brief for this project can be found at https://landscapeperformance.org/case-study-briefs/middle-blue-river-basin-green-solutions-pilot-project

Landscape Performance Benefits

Environmental Benefits

- ***E1 - Reduces stormwater peak runoff flow by 76% (9.2 cfs) and peak volume by 36% (39,000 gallons).***

Background

Prior to implementation of the *Middle Blue River Basin Green Solutions Pilot Project*, the 75-year old Marlborough neighborhood (**Figure E1-1**) was characterized by deteriorating street and sewer infrastructure, and small areas of localized flooding. Curbs or swales were not present along the streets, and stormwater ran down the streets to intersections where it inlet into a combined sewer system. Instead of controlling peak runoff flows using traditional infrastructure like central storage tanks or large detention areas which may not fit neighborhoods in retrofit situations, the city chose to test a green infrastructure approach.

The pilot project is located in the middle reaches of the Blue River Basin watershed in Kansas City, MO (**Figure E1-2**). Celebrated as the first green infrastructure project tested at a neighborhood scale in Kansas City, stormwater runoff was controlled through 81 rain gardens, 36 small bioretention areas, subsurface water storage systems holding 360,320 gallons of stormwater, and permeable paving. Locations of these green infrastructure features are shown in **Figure E1-3**.

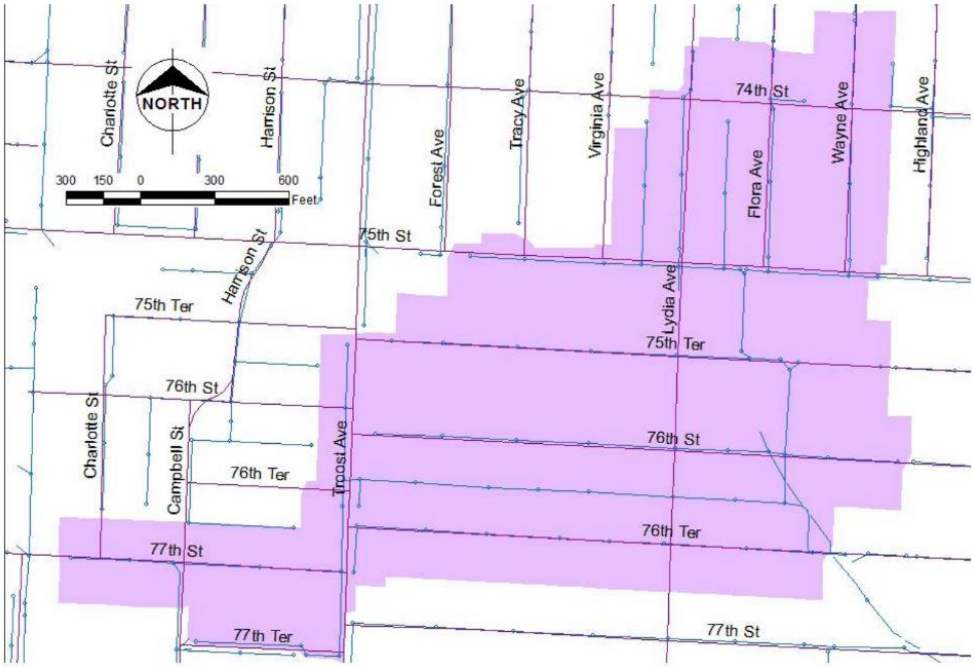


Figure E1-1: Green infrastructure pilot project is located throughout the old Marlborough neighborhood in eastern Kansas City, MO (Kansas City Water Services 2013, p. 8).

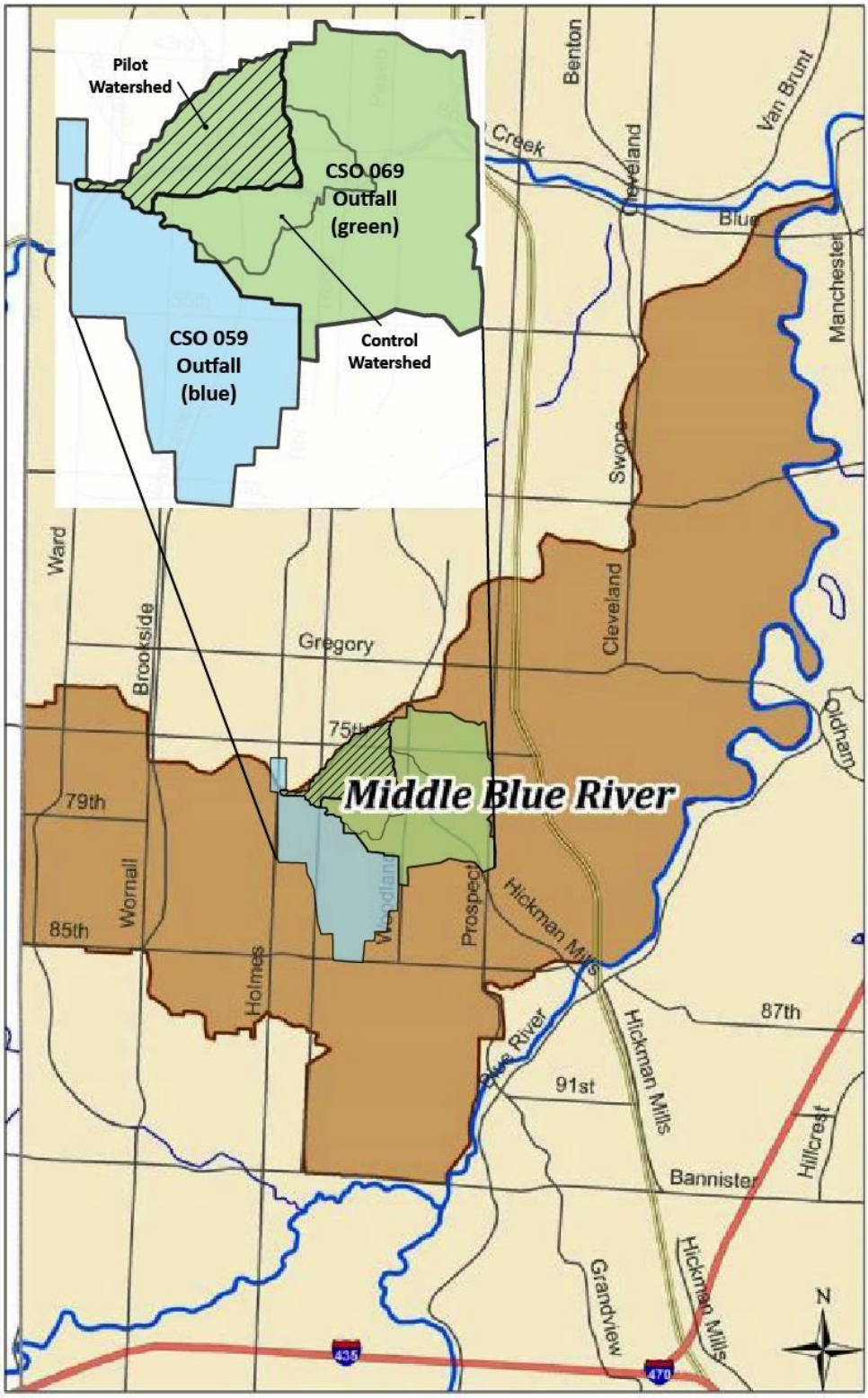


Figure E1-2: Green infrastructure pilot project is located in the middle reaches of the Blue River watershed in Kansas City, MO (Landscape Architecture Foundation, Timothy Kellams 2016, adapted from Kansas City Water Services 2013, p. 9).

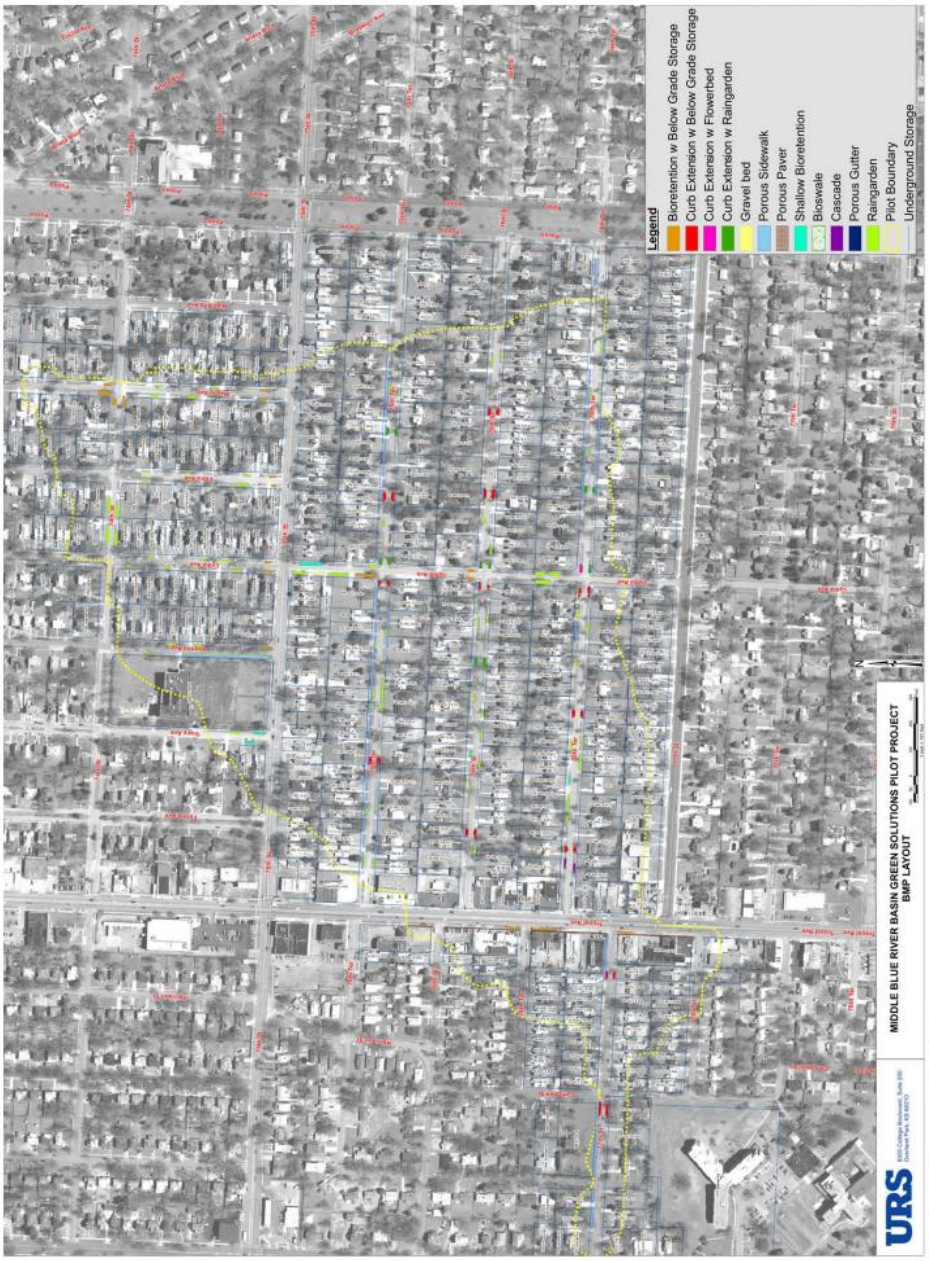


Figure E1-3: Location of rain gardens, bioswales, and bioretention areas and other BMPs of the Pilot Project area (Kansas City Water Services 2013, p. 22).

Methods

According to the "Middle Blue River Basin Green Solutions Pilot Project Final Report" (Kansas City MO Water Services 2013, p.49), reliable post-construction BMP flow data was not available, so a modeled approach was used. Initial hydraulic modeling was conducted and submitted by URS in October 2012 using the XPSWMM hydraulic modeling software. The modeled area includes the pilot project area and an adjacent control area located directly south (**Figure E1-3**). The model was initially calibrated to Darcy's Law equations, but additional calibration utilized precipitation data from three rainfall events in April, May, and June 2013, and monitored BMP flow data (UMKC 01 flow meter) from April 2013. Comparative model results for both the Pilot Area Outlet and Combined Sewer Outfall 069 are summarized in **Table E1-1** excerpted from the November 2013 Final Report issued by Kansas City Water Services. Readers are referred to the report for more detail concerning the modeling methods, calibration methods, and the calibration/verification hydrographs.

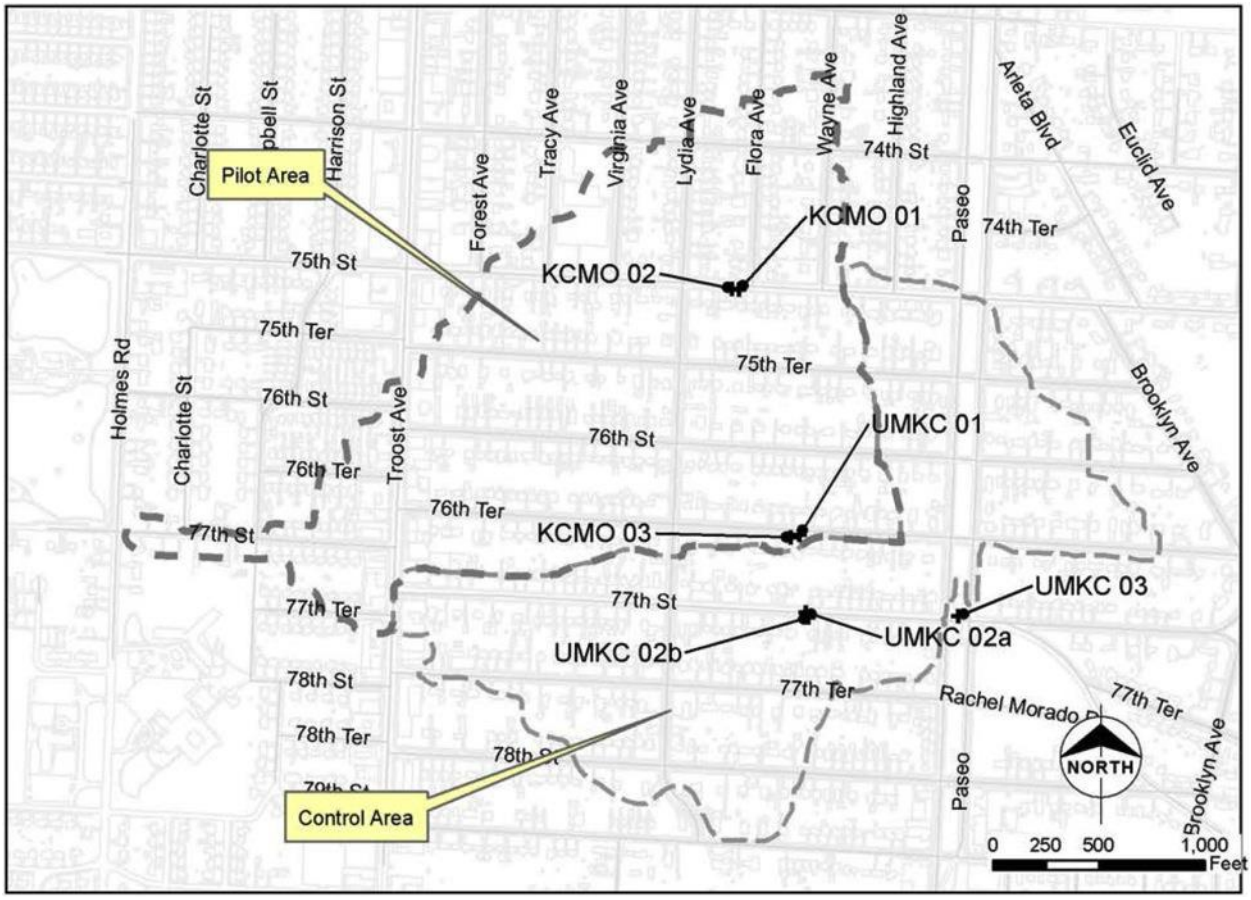


Figure E1-3: Extent of URS hydraulic modeling for the Pilot Area and Control Area. (Kansas City Water Services 2013, p. 49).

Location	Pre-Existing Conditions Model		Calibrated BMP Model		Difference	
	Peak Flow (cfs)	Total Volume (cf)	Peak Flow (cfs)	Total Volume (cf)	Peak Flow (%)	Total Volume (%)
Pilot Area Outlet	12.1	108,600	2.9	69,600	-76.0	-35.9
CSO 069	45.6	184,000	30.9	133,000	-32.2	-27.7

Table E1-1: Comparison of Pre-Existing Conditions and Calibrated BMP Model Results for an OCP Design Storm D (2-mo, 16.75 hr) with a total rainfall depth of 1.4".
(Kansas City Water Services 2015, p. 50).

Calculations
Percent Change: ((y-x)/x) x 100, in which x= original value, y= new value
Pilot Area Peak Flow Reduction: (2.9 cfs - 12.1 cfs)/12.1 cfs x 100 = 76.0% decrease
Pilot Area Total Volume Reduction: (69,600 cf - 108,600 cf)/108,600 cf x 100 = 35.9% decrease
CSO 069 Peak Flow Reduction: (30.9 cfs – 45.6 cfs)/45.6 cfs x 100 = 32.2% decrease
CSO 069 Total Volume Reduction: (133,000 cf – 184,000 cf)/184,000 cf x 100 = 27.7% decrease

Limitations
Only flow data for meter UMKC 01 was available at the time of model calibration, but because of the location, it was still possible to determine the aggregate impact of the BMP installations. Flow meters, KCMO 01, 02, & 03, are now operational, and can be used to determine performance of intermediate BMPs.

Sources
Kansas City Water Services. 2013. "Middle Blue River Basin Green Solutions Pilot Project Final Report." November. Kansas City MO Water Services.

URS. 2012. "XPSWMM Hydraulic Model--BMP Impact and Calibration Report." October.

- ***E2 – Captures and infiltrates up to 360,320 gallons of stormwater per 1.4-in storm event.***

Methods
Engineering sizing calculations as part of project design of various BMP features. Runoff stored through the utilization of permeable pavers, porous concrete, rain gardens, and subsurface storage systems.

Calculations
Stormwater storage capacity tabulations and calculations were performed by project engineers

and reported in the “Middle Blue River Basin Green Solutions Pilot Project Final Report” (Kansas City Water Services 2013).

Limitations
Reported stormwater storage capacity is what is available, not the extent of measured utilization.

Sources
Kansas City Water Services. 2013. “Middle Blue River Basin Green Solutions Pilot Project Final Report”. November.

- ***E3 - Reduces overall stormwater runoff by approximately 80%.***

Methods
This benefit summarizes the work of graduate student Yanan Ma at the University of Missouri-Kansas City funded by EPA through a contract with Tetra Tech, Inc.

Stormwater runoff from the 100-acre pilot project area, and an adjacent 80-acre control watershed, was measured and averaged using four operational Teledyne ISCO 2150 Area Velocity Module flowmeters. A rain gauge and data logger was installed at 77th Street and the Paseo, supplemented with other rainfall loggers at Brooklyn PS, and 75th Terrace and Troost. Monitoring began in the Pre-Construction period (no rain gardens) using 24 rain events from 12/27/2008 to 6/3/2010. Monitoring was interrupted from 08/2010 to 01/2011 when the pipe system being monitored was relined and rehabilitated. After completion of the pipe repair, pre-construction monitoring resumed and 6 rain events were recorded from 2/27/2011 through 5/8/2012 during which time construction of the 135 rain gardens started. Post-Construction monitoring recorded 8 rain events during the period 11/11/2012 to 5/31/2013 (extent of thesis data). During the pipe repair period (pre-construction period), the flowmeters malfunctioned and only velocity was recorded. Using the continuity equation (Q=VA) since the Post-Construction period used the same pipe system, flow rate was reconstructed and a regression analysis established the upper uncertainty range.

Readers are referred to the thesis for step-by-step data analysis and calculations leading up to runoff percentage (runoff depth/rainfall depth), normalizing for rainfall differences within and between the Pre- and Post-Construction comparison periods.

Runoff percentage: 21% (Pre-Construction period)
Runoff percentage: +/- 41% (Pre-Construction period after pipe repair)
Runoff percentage: 7.6% (Post-Construction period)

The runoff percentage increase after the monitored flow pipe repair during the Pre-Construction period indicates the amount of leakage taking place resulting in under-measured runoff. Therefore the +/-41% number is used and pipe conditions are consistent with the Post-

Construction (completed rain garden) period. Runoff differences are concluded to be attributable to flow reduction through rain garden infiltration.

Data analysis is in [general] agreement with a detailed WinSLAMM hydrologic model which compared runoff volume from test and control areas (p 33).

Calculations
Reduction of runoff percentage: (+/-41% - 7.6%)/41% = +/- 81.5%

Limitations
Extra calculations and modeled corrections were needed for malfunctioning flowmeters. Individual flowmeters also became non-operational on occasion which required compensational adjustments to the total flow volume being measured.

Sources
Ma, Yanan. 2013. "Watershed-Level Analysis of Urban Rain Garden Performance", Master's thesis, University of Missouri-Kansas City. Published by ProQuest LLC. UMI Number: 1547661.

- ***E4 - Sequesters an estimated 3,831 lbs of atmospheric carbon annually through 134 trees, equivalent to driving a single-passenger vehicle 4,165 miles. The tree canopies also intercept an estimated 822 gallons of stormwater runoff annually.***

Methods
Referencing Kansas City Water Service Department 2013 Tree inventory and i-Tree projections. Species identification and diameter breast height (DBH) were recorded, then the atmospheric carbon sequestration (lbs) and intercepted stormwater runoff (gal) per tree species and number of trees were calculated using the National Tree Benefit Calculator (NTBC). The inventory, along with calculated metrics, is included in **Table E3-1**.

Tree Common Name	Other Tree (if used)*	Stormwater interception by one tree (gal)*	CO2 reduction by one tree (lbs)	Annual benefit of one tree ($)	Number of tree found on site	Total Intercepted stormwater runoff (gal)	Total CO2 reduction (lbs)	Total annual benefit ($)
Hedge Maple	Amur Maple	18	24	3	8	24	144	192
Red Maple		33	24	5	9	45	297	216
Honeylocust		46	39	7	11	77	506	429
Blackgum	Sweetgum	44	26	10	3	30	132	78
Swamp White Oak		37	37	9	24	216	888	888
Shumard Oak	Northern Red Oak	44	33	7	6	42	264	198
Japanese Tree Lilac		18	24	3	60	180	1080	1440
Lacebark Elm	Siberian Elm	40	33	16	8	128	320	264
Japanese Zelkova	Siberian Elm	40	33	16	5	80	200	165
Total					**134**	**822**	**3831**	**3870**
						(gal)	**(lbs)**	**($)**

*Equivalent Tree used when particular species was not available in software
**Install size for all trees was 2-inch caliper

Table E3-1: Tree Inventory for Middle Blue River Basin Pilot Project and environmental benefits estimated through the National Tree Benefit Calculator (Kellams 2016).

Calculations

Calculations were conducted using the National Tree Benefit Calculator (NTBC). The tree type, diameter, tree location by region, and land-use are entered into the NTBC. The NTBC then uses an internal formula to to develop stormwater, property value, energy, air quality, and atmospheric carbon reduction metric. These all help produce an overall benefit of the tree in U.S. dollars. More information concerning the approach and internal calculation methods can be found at:
http://www.itreetools.org/streets/resources/Streets_Reference_Cities_Science_Update_Nov2011.pdf

Limitations

There are a few limitations using this method. Some of the inventoried trees were not included in the National Tree Benefit Calculator/i-Tree database, so appropriate substitutions were made. This is also a projected, not measured metric.

Sources

Kansas City Water Service Department 2013 Tree inventory.

National Tree Benefit Calculator:
http://www.treebenefits.com/calculator/treeinfor.cfm?zip=&city=&state=&climatezone=Midwest

United State Environmental Protection Agency Greenhouse Gas Equivalencies Calculator. Accessed May 18, 2017: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Social Benefits

- ***S1 - Improves the overall appearance of the neighborhood for 69% of 22 surveyed residents.***

  Improves the overall appearance of the neighborhood for 69% of 22 resident respondents who indicated "definitely improved" (64%) or "somewhat improved" (5%).

- ***S2 – Appeals aesthetically to 64% of 22 surveyed residents through the addition of the streetside rain gardens.***

  64% of surveyed residents liked the appearance of the streetside rain gardens "very much" (32%) or "somewhat" (32%).

Methods

For Social Benefits S1 and S2, an introduction letter and 14-question paper based survey was mailed to 162 neighborhood residences within the pilot project area. The introduction letter also contained a web address for optionally taking the survey online via the KSU Qualtrics system if more convenient. Since the survey involved human subjects, solicited opinions, and research results would be published, the survey was submitted to the Kansas State University Institutional Review Board (IRB) to ensure that no significant risks were anticipated and proper research protocols were followed. After review, the survey was determined to be exempt under the category 45 CFR 46.101 (b)(2) (Proposal #8333).

The survey response rate was 13.6%, considered typical for this type of survey without employing door-to-door follow-up by researchers who would also require IRB training (not part of IRB application and outside the available timeframe). Most respondents (90.9%) chose to use the paper-based questionnaire returned via a postage-paid envelope to the survey administrator. The survey questions and results can be found in **Appendix A**.

Calculations

Results were summarized by simple tabulations and percentage breakdowns.

Limitations

Although the response rate was typical, a larger sample size might be more representative. There is also a possibility that people having a negative reaction to the pilot project might be more motivated to respond.

Sources

Hahn, Howard, Timothy Kellams, Lisa Teese, and Jim Schuessler. 2016. "Survey of Potential Social Benefits of the Middle Blue River Basin Green Solutions Pilot." Administered July 22-Aug 24. Landscape Architecture Foundation Case Study Investigation: *Middle Blue River Basin Green*

Solutions Pilot Project, Kansas City, MO.

Economic Benefits

- ***Ecn1 – Contributed to rebounding home values in the pilot area to within -1.36% of 2012 values, compared to -18.72% in the control area which did not receive rain gardens and visual improvements to streets, gutters, and sidewalks, within the context of Kansas City housing value decreases following national trends.***

Methods

Property values in the pilot project area are dependent on many factors: the rate of the national economic recovery, the relative strength of the Kansas City, MO housing market, and general market values of the entire Marlborough neighborhood dependent on age/condition of the housing, lot/structure size, quality of surrounding schools, and other local factors. Any potential housing value gains due to project improvements including street/curb upgrades, sewer rehabilitation (not visible), sidewalk installation/repair, and streetside rain gardens are anticipated to be slight and masked within the overall market recovery trend. **Figures Ecn1-1** and **Ecn1-2** show housing market trends for Kansas City, MO (2007-2016) and the Marlborough neighborhood area (2011-2016). The housing market underwent a substantial decrease in 2009, which continued to a lowpoint in late 2012. Since that time, the housing market is slowly recovering, but is nowhere near the pre-2009 high.

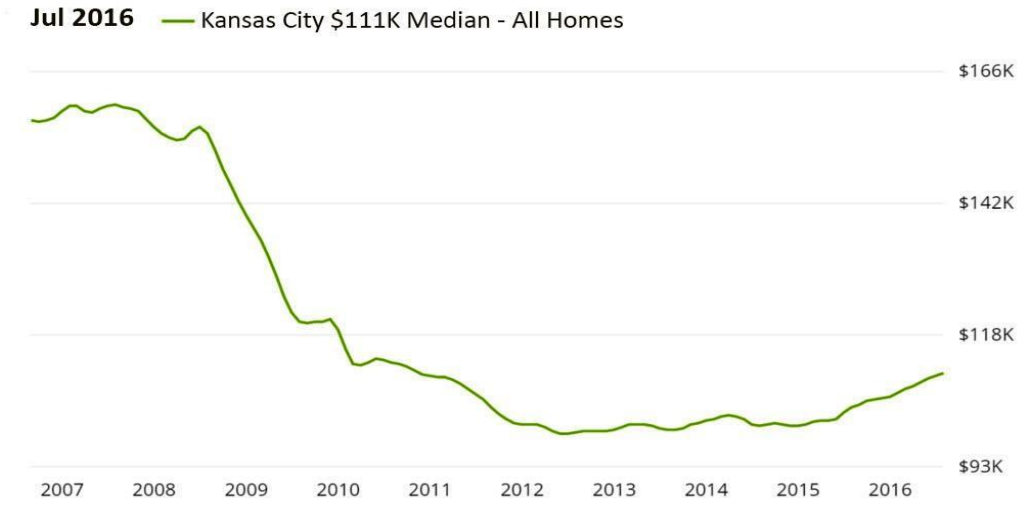


Figure ECN1-1: Housing market trend for Kansas City, MO (2007-2016) (Zillow 2016a).

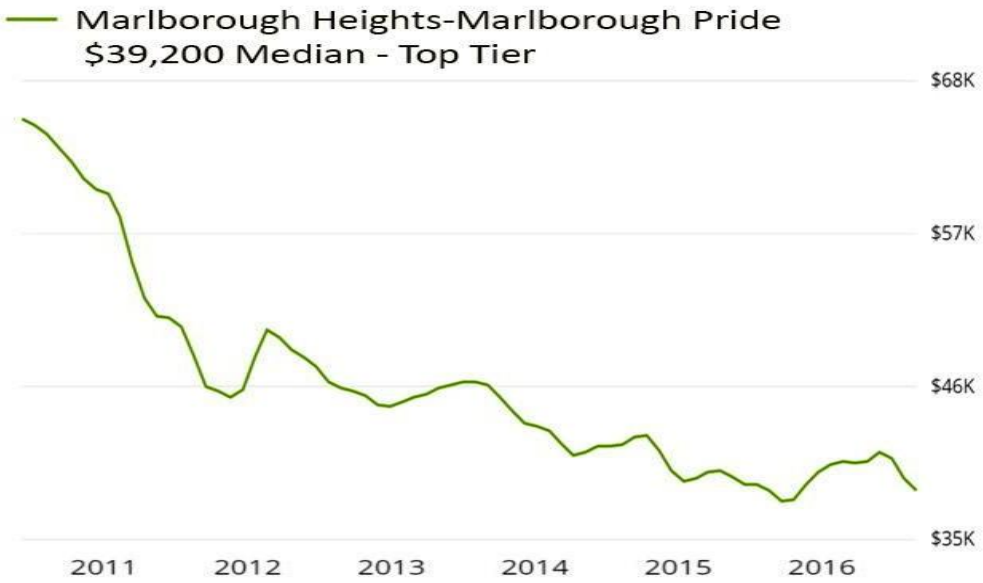


Figure ECN1-1: Housing market trend for the Marlborough Heights-Marlborough Pride Neighborhood in eastern Kansas City, MO (2011-2016) (Zillow 2016b).

Within this housing market context, potential changes in housing values attributable to improvements within the pilot project area were compared against streets located south of the pilot project area that received no improvements. Zillow (www.zillow.com) property value data ("zestimates") were compiled for 58 randomly selected addresses within the pilot project area (**Appendix B**). Zestimates are not appraisals, but are useful for comparative analysis. The valuation formula behind the estimate is proprietary, and is based on physical attributes (location, lot size, number of bedrooms, etc.), tax assessment records, and prior and current real estate transactions.

Property value estimates were sampled for November 2012 (project completion), February 2015, and August 2016. In addition, the house square footage and sales history was included. Upon inspection of the data, two addresses were culled as being non-representative; the square footage of one house (2,878 sf) was double the sample average, and another house was a foreclosure property that posted extraordinary appreciation (174%) over four years. Of the remaining 56 sampled houses, 28 houses were fronted by streetside rain gardens (BMPs), and 28 houses were not BMP locations, but received street, gutter, and sidewalk improvements.

As a comparative control, 20 houses were selected in an adjacent area south of the pilot project area within the same neighborhood. Incidentally, this is the same control area used for the stormwater runoff analysis within Outfall 059 (Figure E1-3). The control area contains similar housing type, style, age and property values compared to the pilot project area before improvements. All of the sampled address locations for the pilot project and control areas were then mapped using GIS (**Figure Ecn1-3**).

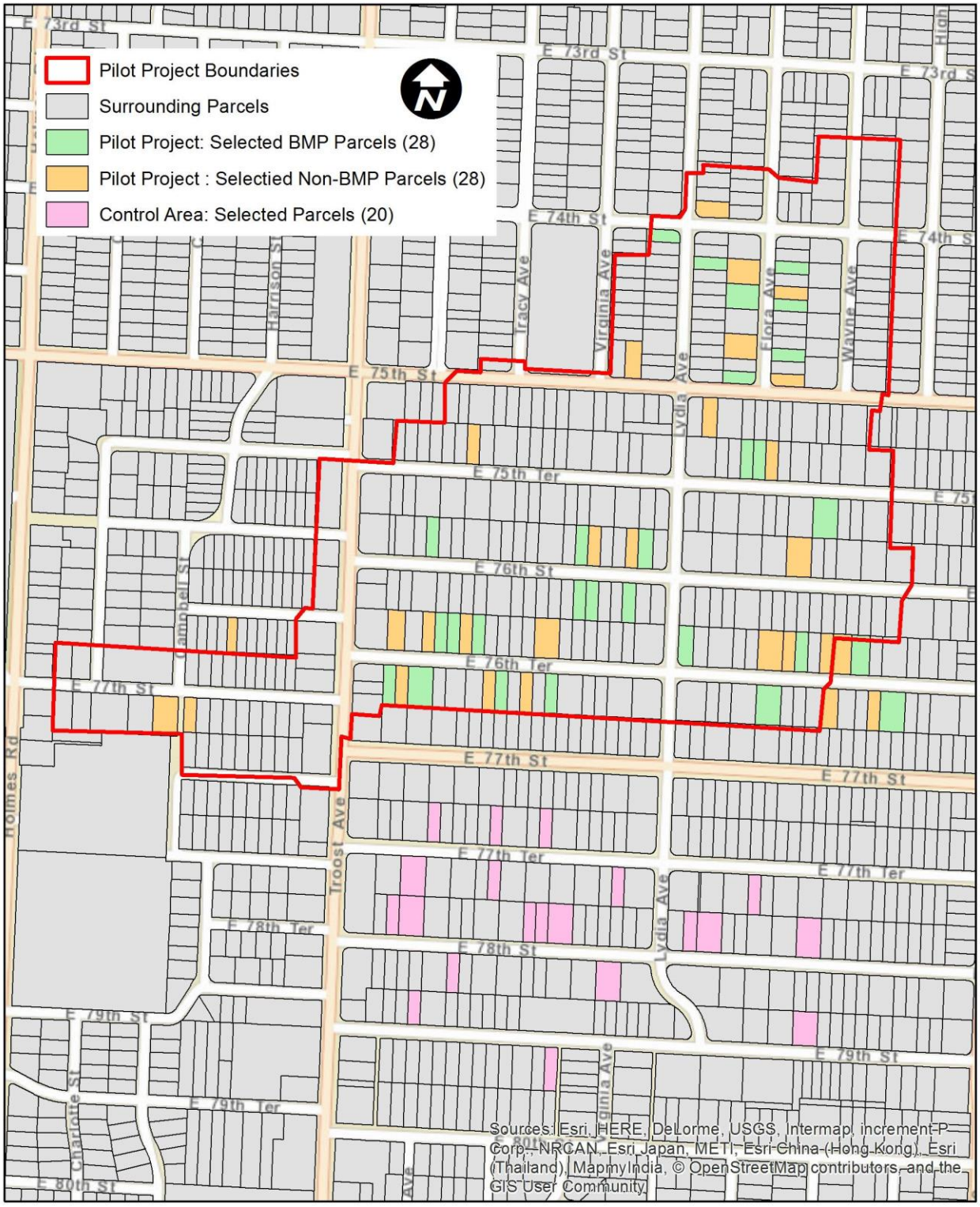


Figure Ecn1-3: Sampled address locations in pilot project and control areas. (Hahn 2016)

The average sampled housing values within the pilot project area and control area are shown in **Tables Ecn1-1** and **Ecn1-2** respectively (see **Appendix B** for the detailed data). Note that the 28 homes with no BMPs shown in Table Ecn1-1 are still benefitting from street, curb, and sidewalk

improvements within the pilot project area.

SUMMARY	Avg. SF	11/12/2012 Zestimate	2/1/2015 Zestimate	8/1/2016 Estimate	2012-2016 % Change: Avg per Parcel % Change	2012-2016 % Change: % Change of Column Avg.
Average: All 56 homes	**1,311**	**$ 61,309**	**$ 41,273**	**$ 60,474**	**2.6%**	**-1.36%**
Avg per SF		$ 46.75	$ 31.47	$ 46.11		-1.36%
Avg: 28 Homes w/ BMP	**1,273**	**$ 55,964**	**$ 35,714**	**$ 54,549**	**1.1%**	**-2.53%**
Avg per SF		$ 43.98	$ 28.06	$ 42.86		-2.53%
Avg: 28 Homes no BMP	**1,332**	**$ 64,464**	**$ 45,357**	**$ 64,239**	**4.0%**	**-0.35%**
Avg: per SF		$ 48.41	$ 34.06	$ 48.24		-0.35%

Table Ecn1-1: Averaged estimated housing values for 56 sampled homes within the pilot project area between 2012-2016 (Zillow 2016c).

SUMMARY	Avg. SF	11/12/2012 Zestimate	2/1/2015 Zestimate	8/1/2016 Estimate	2012-2016 % Change: Avg per Parcel % Change	2012-2016 % Change: % Change of Column Avg.
Average: 20 homes	**1,446**	**$ 68,750**	**$ 41,450**	**$ 55,878**	**-17.3%**	**-18.70%**
Average per SF		$ 47.53	$ 28.66	$ 38.63		-18.70%

Table Ecn1-2: Averaged estimated housing values for 206 sampled homes within the control comparison area between 2012-2016 (Zillow 2016c).

In both tables, the "Avg per Parcel % Change" column is the average of the individual home value % changes from 2012 to 2016 as depicted in each row of the full data table (Appendix B). This calculation is more sensitive to individual changes in home appreciation/depreciation. The "% Change of Column Avg" column is the simple calculation of housing value % change between 2012 and 2016 after the housing values have been averaged for the column. This calculation, which is the one used the pilot area-control area comparison, tends to average out anomalies like foreclosure properties which are typically bought low and show large appreciation gains which skew the individual home value gains/losses within the overall neighborhood and are not reflective of values possibly attributable to pilot project improvements.

The first conclusion that can be drawn for both comparison areas is that housing values are lower in 2016 than 2012, but are rebounding from an intermediate low in 2015. From the summary averages, it is clear that the pilot project area was not hit as hard in 2015 (or slightly before) as the control area and is rebounding at a faster rate: -1.36 % average value change for the pilot project area vs. -18.70% value change for the control area. Since the housing and overall neighborhood characteristics of the comparison areas are similar and only separated by several streets, it appears that the pilot project improvements are contributing to a higher perceived image reflected in the housing value difference.

Calculations

Pilot Project Area: ($60,474 (2016) - $61,309 (2012))/ $61,309 (2012) x 100= -1.36%
Control Area: ($55,878 (2016) - $68,750 (2012))/ $68,750 (2012) x 100 = -18.72%

Limitations
None.

Sources
Zillow. 2016a. "Housing market trend for Kansas City, MO (2007-2016)." Accessed August 29: http://www.zillow.com/kansas-city-mo/home-values/

Zillow. 2016b. "Housing market trend for the Marlborough Heights-Marlborough Pride Neighborhood (2011-2016)." Accessed August 29: http://www.zillow.com/marlborough-heights-marlborough-pride-kansas-city-mo/home-values/

Zillow 2016c. "Housing Values." Accessed August 14: http://www.zillow.com/homes/

Cost Comparison

The total constructed cost of the 100-acre pilot project was $10.41 million, and the "green infrastructure" portion cost $6.02 million for 360,320 gallons of storage equating to $16.71 per stored gallon. As a means to compare against a "grey infrastructure" approach, a 3 million gallon storage tank alternative first proposed in 2008 was used. This alternative included storage tanks, screening facilities, and outflow pumping station at a total cost of $50.6 million, resulting in a constructed storage cost of $16.87 per gallon. The cost difference between the approaches is less than 1%; however, the green infrastructure exceeds a 2008 estimate of $10.36 per stored gallon across the entire 069 Outfall.

A more complete cost comparison would account for equivalent performance (gallons stored), maintenance over time, and offsetting direct or indirect benefits. Measured performance data has not been fully released yet, and maintenance costs over time are still being evaluated.

Methods
A recent summary by Kansas City Water Services puts green infrastructure for the entire Overflow Control Program (OCP) in budget context (**Figure CS-1**), and context with other strategy elements and number of projects (**Figure CS-2**). In reality, the pilot project is probably most accurately described as a "green-grey" infrastructure hybrid project if the sewer rehabilitation is included.

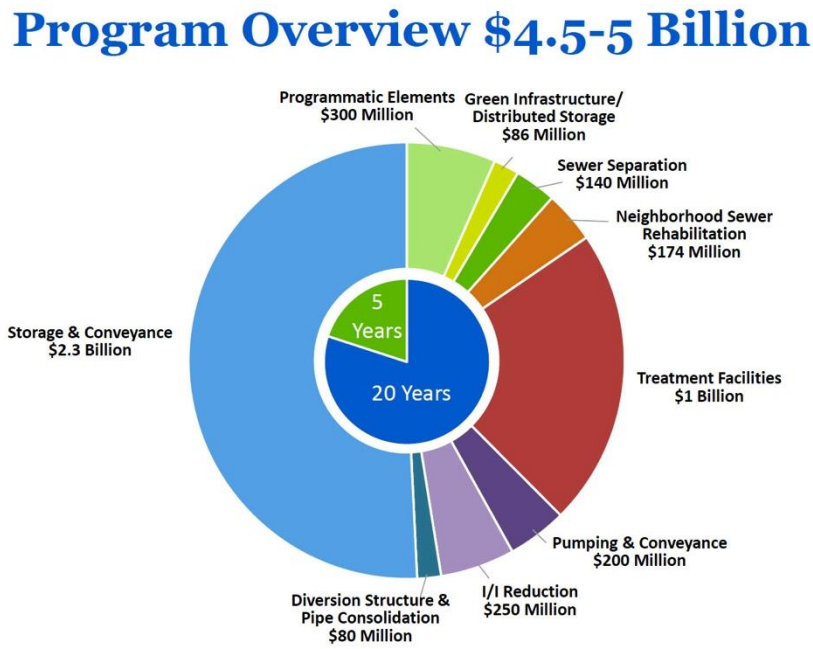


Figure CS-1: Overflow Control Program Overview of Various Strategy Elements in 2035 Dollars. (KCWS 2016, slide 20).

Figure CS-2: Comparison of Overflow Control Program Elements in 2035 Dollars. (KCWS 2016, slide 21).

The full cost of the green infrastructure approach compared to conventional infrastructure on an equivalent basis needs to account for performance, "triple bottom-line" considerations, and maintenance over time. Since measured performance data for the Middle Blue River Pilot Project has not been released by the EPA as of August 2016, the constructed cost of the green infrastructure/distributed storage pilot project will be simply compared to the cost of a storage tank alternative proposed in 2008. The storage tank alternative (grey infrastructure) is mentioned in the *Kansas City Overflow Control Program Report* (KCWS 2012, p 10-13), *Green Alternatives for Outfalls 059 and 069 Report* (KCWS 2008), and the *Middle Blue River Basin Green Solutions Pilot Project Final Report (KCWS 2013, p10)*. This alternative consists of two storage tanks having a combined capacity of 3 million gallons, screening facilities, and outflow pumping station at a cost of $50.6 million (2006 dollars) (KCWS 2008, p. 3).

The green infrastructure and grey infrastructure (storage tank) cost comparison is presented in **Table CP-**1. Overflow reduction targets, costs of overflow control measures, and the cost of the storage tank alternatives for the 069 and 059 outfalls, and the smaller pilot project site (100 ac).

	Overflow Control Plan Allocation	
Middle Blue River Basin[a] Typ. Wet Weather Flow: 623 million gal Former Overflow: 149 million gallons (MG) Est. Future Overflow: 27 MG Reduction Target: 122 MG	$90.99 million[a] (estimated 2012 $) (all OCP strategies)	
Green-Gray vs. Grey Infrastructure Comparison (mid-2006 dollars)	**Estimated Capital Costs "Green-Grey Alternative"**	**Estimated Capital Costs "Grey Alternative"**
Area Tributary to Outfall 069 (475 ac) Green Storage Needed: 2.375 MG Grey Storage Needed: 2 MG	$24.6 million[b,c] (estimated) ($10.36/gallon)	$30.6 million[b] (estimated) ($15.30/gallon)
Area Tributary to Outfall 059 (269 ac) Green Storage Needed: 1.125 MG Grey Storage Needed: 1 MG	$10.3 million[b] (estimated) ($9.16/gallon)	$20 million[b] (estimated) ($20.00/gallon)
Total for Outfalls 069 + 059 (744 ac) *Green Storage Required: 3.5 MG (includes storage + 6 hrs pumping during peak events* *Grey Storage Required: 3 MG*	$34.9 million[b] (estimated) ($9.93/gallon)	$50.6 million[b] (estimated) ($16.87/gallon)
069 Outfall[c (p.4)] as measured Volume reduction: 292,000 gallons		
Pilot Project (100 ac) Total Cost (located in Outfall 069)	$10.41 million[d] (actual)	

Green Infrastructure portion (360,320 stored gal)[e]	$6.02 million[d] (actual) = $16.71/gal	
Sewer Rehabilitation portion*	$2.97 million[d] (actual)	
Street Improvements portion*	$1.42 million[d] (actual)	

Table CP-1: Construction Cost Comparison ($/overflow gallon stored) Between Green-Grey Infrastructure and Grey Infrastructure (Storage Tank) Alternatives for the Middle Blue River Basin and Smaller Pilot Project (Landscape Architecture Foundation: Howard Hahn 2016).

[a] Kansas City Water Services, *Overflow Control Plan (OCP)*. 2012, p.10-12, Table 10-2: Summary of Estimated Cost and Performance, Updated CCP from 2008. (extraction and reformat).

[b] Kansas City Water Services, *Green Alternatives for Outfalls 059 and 069 Report* (June 10, 2008, pp 2-3).

[c] Kansas City Water Services, *Middle Blue River Basin Green Solutions Pilot Project Final Report.* 2013, p.10.

[d] KCWS (2013, p. 52)

[e] Storage includes temporary ponded water in rain gardens and bioretention areas, saturation storage in bioretention soil mix (40% void), and in-pipe storage; no estimate of infiltration included (factor being measured).

*Necessary for green infrastructure to work properly due to specific sewer/street conditions, and for social benefits (part of triple bottom line).

Interpreting the raw "green" and "grey" infrastructure approaches is not straightforward for the pilot project. One factor to consider is whether the pilot project was a "green infrastructure" or a "green-grey" hybrid due to the distributed underground storage that was costed under the green infrastructure portion of the budget. Since the distributed underground storage is integral to the planned green infrastructure functioning and performance, it is assumed to be a valid inclusion in the "green" category.

Another consideration is whether the storage tank alternative should be compared against the total pilot project cost or just the green infrastructure portion. To some degree, street improvements and curb installation were necessary to properly direct runoff water into the street-side rain gardens and bioretention areas. However, the street improvements and sewer rehabilitation extensively described in KCWS (2013, p. 48) could have also been necessary to convey runoff to the storage tanks of the "grey infrastructure" alternative, and meet the same community goals. Inclusion of the extra street and sewer rehabilitation costs do not represent typical conditions, and may be unnecessary in future green infrastructure project locations.

The preliminary engineering study and cost estimate for the storage tank alternative prepared in 2008 did not take into account the specific street/sewer conditions of the pilot project area (KCWS 2008, p 3); therefore the "green" approach also should not include these extra conditions for an equivalent comparison. For all these reasons, the "green-grey" and "grey"

comparison will not include the costs of the street improvements and sewer rehabilitation.

Since the capacity utilization and detailed performance measurements have not yet been released for the pilot area, the cost comparison will simply compare the constructed price per gallon between the green-grey infrastructure approach and the grey infrastructure (storage tank) approach.

Calculations

According to the City's *Overflow Control Plan (OCP)* (KCMO Water Services 2012), green infrastructure could be a viable option and is included in the range of treatment strategies underway to meet the City's overflow volume reduction goals. For the full range of overflow reduction strategies, the city committed to a plan requiring $2.3 billion (2008 dollars) in capital costs that will extend to 2035 at which time the capital costs will be $4.5-5 billion when complete. At the overall OCP scale, green infrastructure/distributed storage represents 1.9% ($86 million/$4,530 million) of total projected OCP infrastructure cost by 2035. In 2012 dollars, the budget for the full range of OCP strategies for the Middle Blue River Basin portion is $90.99 million.

With this context in mind, the total constructed cost of the 100-acre pilot project was $10.41 million, and the "green infrastructure" portion cost $6.02 million for 360,320 gallons of storage equating to $16.71 per stored gallon. As a means to compare against a "grey infrastructure" approach, a 3 million gallon storage tank alternative first proposed in 2008 was used. This alternative includes storage tanks, screening facilities, and outflow pumping station at a total cost of $50.6 million, resulting in a constructed storage cost of $16.87 per gallon.

Grey Infrastructure Construction Cost: $6.02 million / 360,320 gallons = $16.87 per gallon

Green Infrastructure Construction Cost: = $50.6 million / 3,000,000 gallons = $16.71 per gallon

Cost Difference: ($16.87/gal - $16.71/gal)/$16.87/gal = 0.95%

Limitations

Comparing just construction cost per stored gallon, the green infrastructure cost is very close to grey infrastructure cost per gallon, and far exceeds the composite 2008 "green-grey" estimate for combined Outfalls 069 and 059 by $6.78/gallon. Currently, engineers are looking for ways to bring down the green infrastructure cost per stored gallon within expectations.

Until more pilot area flow data is released, the cost comparison between the "green" and "grey" infrastructure only considers construction cost per stored gallon, not equivalent performance cost per gallon. If performance is assessed by total overflow gallons reduced, the reduction benefits of infiltration associated with green infrastructure are not being considered

which would make green infrastructure costs lower. Also, indirect cost benefits like the reduction of volume and pollutant load in stormwater flowing to the combined sewer system, destined for the wastewater treatment plant, are not being considered in the accounting.

Sources

Kansas City Water Services (KCWS). 2008. *Green Alternatives for Outfalls 059 and 069.* Report (June 10).

Kansas City Water Services (KCWS). 2012. *Overflow Control Plan (OCP)*. January 30, 2009 (Revised April 30, 2012). City Contract 770, City Project 81001. Accessed August 5: https://www.kcwaterservices.org/wp-content/uploads/2013/04/Overflow_Control_Plan_Apri302012_FINAL.pdf

Kansas City Water Services (KCWS). 2013. *Middle Blue River Basin Green Solutions Pilot Project Final Report* (November). Accessed August 5: http://www.burnsmcd.com/Resource_/PageResource/Overflow-Control-Program-Assistance/Final-Report-Kansas-City-Overflow-Control-Program-Middle-Blue-River-Basin-Green-Solutions-Pilot-Project-2013-11.pdf

Kansas City (MO) Water Services. 2016. "KC Water Cost of Service Task Force Meeting #4" slide presentation, July 19, 2016. Accessed August 5: https://www.kcwaterservices.org/wp-content/uploads/2016/05/KCWater_COS_Presentation_Meeting1_071916_FINAL.pdf

Sustainable Features

- ***Sustainable Feature - Increases walkability for 162 residents in the project area with 5,400 ft of new ADA accessible sidewalk in locations where no sidewalk previously existed or existing sidewalks in disrepair were replaced.***

Calculations

None

Limitations

Although the survey indicated that a majority (55%) of the resident respondents have observed more people using the sidewalks, a significant 45% have not (Question 10). A better measure would be to conduct direct observational analysis or door-to-door survey to increase the sample size.

Sources

Kansas City Water Services. 2016. "Middle Blue River Green Solutions Pilot Project Powerpoint Overview", Slide 23. Accessed August 16: http://kcdv.tv/big-muddy-speakers-series/2014/03_march/lara-isch/index.html

- ***Sustainable Feature: Provided subject matter for educational tours and opportunities to visitors and inhabitants of approximately 162 residences with 6 interpretive and educational signs about the sustainable implementations of the project, which includes permeable pavers, porous sidewalk and rain gardens.***

Methods
The Kansas City Water Services Department has conducted several educational tours of the pilot project neighborhood as documented in the "Middle Blue River Green Solutions Pilot Project Final Report." The bus tours have generally been for visitors to Kansas City for conferences and professional organizations requesting tours. Residents sometimes come outside during the tours and listen to the presentations. There was one tour for City Council members, which also included neighborhood leaders.

Calculations None

Limitations
Other than the tours and general observation, no in-person or mailed surveys have been used to assess how often signs are read or to what degree the signs are understood.

Sources
Kansas City Water Services. "Middle Blue River Basin Green Solutions Pilot Project Final Report". November 2013. Kansas City, MO.

Appendix A

Survey Mailed to Residents in the Middle Blue Pilot Area: IRB Approval

KANSAS STATE UNIVERSITY | University Research Compliance Office

TO: Howard Hahn
LARCP
303i Seaton

Proposal Number: 8351

FROM: Rick Scheidt, Chair
Committee on Research Involving Human Subjects

DATE: 07/08/2016

RE: Proposal Entitled, "Survey of the Social Benefits for Residents of the Middle Blue River Basin Green Solutions Pilot."

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written – and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §46.101, paragraph b, category: 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

203 Fairchild Hall, Lower Mezzanine, 1601 Vattier St., Manhattan, KS 66506-1103 | 785-532-3224 | fax: 785-532-3278 | k-state.edu/research/comply | comply@ksu.edu

Mailed Cover Letter & Survey Mailed to Residents in the Middle Blue Pilot Area

You are Invited to
Participate in a Survey

July 2016

Dear Neighborhood Resident,

Over the past several years, Kansas City Water Services has been investing in the Middle Blue River Basin Green Solutions Pilot Project in your neighborhood, including the installation of rain gardens designed to hold rainwater onsite and release it slowly into the sewer system. You are receiving this letter because we are interested in your opinion. Please consider taking a few moments to participate in this short survey.

This survey is part of case study research on landscape performance being prepared by the Landscape Architecture Foundation and Kansas State University researchers. Examples of these case studies can be found at www.landscapeperformance.org/case-study-briefs.

The survey is entitled "Survey of Potential Social Benefits of the Middle Blue River Basin Green Solutions Pilot." The survey consists of 13 questions and should only take 5-12 minutes to complete. Participation is voluntary, there are no anticipated risks, and all responses will be anonymous. You do not need to answer every question. Aggregated results will be part of the case study write-up and will be available for on-line viewing at www.landscapeperformance.org/case-study-briefs in September 2016.

Your participation in the survey indicates your consent. There are two ways to participate:

➡ 1) Follow the link at https://kstate.qualtrics.com/SE/?SID=SV_eL5rqkQgidf2bzf

--Or --

➡ 2) Complete the attached paper survey and return via mail using the postage-paid envelope. Responses will be accepted until August 3, 2016. Return to: Howard Hahn, KSU, 303i Seaton Hall, Manhattan, KS 66506

Thank you for your time.

Sincerely,

Howard Hahn
Associate Professor, Landscape Architecture and Regional & Community Planning, Kansas State University,
hhahn@ksu.edu

with collaborator:
Timothy Kellams, landscape architecture graduate student

Should you have any concerns about your participation, please feel free to contact the Kansas State University Research Compliance Office at: 203 Fairchild Hall, Manhattan, KS 66506 (785-532-3224); comply@k-state.edu

Landscape Architecture Foundation
2016 Landscape Performance Case Study

"Survey of Potential Social Benefits of the Middle Blue River Basin Green Solutions Pilot"
Administered to Pilot Project area residents July 22-Aug 24, 2016
Postage-Paid Return Mail Respondents: North of 75th St. = 3; South of 75th St. = 17
Online Respondents (North & South of 75th St) = 2

1. Please indicate the directon of your residence fom 75th Street:

Response	*%*	*Response options*
5	23%	North of 75th Street
17	77%	South of 75th Street
0	0%	Prefer not to answer
22		Total responses

2. Please tell us your level of overall satisaction with the recent streetside rain gardens in your neighborhood?

Response	*%*	*Response options*
6	30%	Very satisfied
4	20%	Satisfied
4	20%	Neutral
1	5%	Unsatisfied
5	25%	Very unsatisfied
20		Total responses

3. What do you think about the number of rain gardens that were installed to control rainwater runoff?

Response	*%*	*Response options*
2	10%	More rain gardens should have been installed
5	25%	Fewer rain gardens should have been installed
7	35%	Just the right amount of rain gardens were installed
6	30%	Do not know or have no opinion
20		Total responses

4. Do you think that traffic in your neighborhood has slowed down since completion of the pilot project?

Response	*%*	*Response options*
3	13%	Definitely slower
7	30%	Somewhat slower
12	52%	No apparent change
1	4%	Seems faster
0	0%	Undecided
23		Total responses

5. Do you think the overall appearance of your neighboorhood has improved since completion of the project?

Response	%	Response options
14	64%	Definitely improved
1	5%	Somewhat improved
2	9%	No apparent change
5	23%	Seems worse
0	0%	Undecided
22		Total responses

6. Do you feel that safety within your neighborhood has improved since completion of the project?

Response	%	Response options
1	5%	Definitely safer
7	33%	Somewhat safer
9	43%	No apparent change
4	19%	Seems worse
0	0%	Undecided
21		Total responses

7. Do you like the landscape appearance of the streetside rain gardens?

Response	%	Response options
7	32%	Like very much
7	32%	Like somewhat
2	9%	Neutral
1	5%	Dislike somewhat
5	23%	Dislike very much
22		Total responses

8. What are some specific features related to the appearnce of streetside rain gardens that you like or dislike?

Like:

- Use of colors
- The plants help the [__?] look better and city keeps them trimmed
- I like the upright steel markers with reflectors on bump-outs. I think they look good. Nice art (minimalist)
- Provides better scenery for the neighborhood
- Wide variety of plants
- Gives the neighborhood a clean and cared for look

Dislike:

- Needs more colors; Grass which turns brown in fall and winter
- Some plants are too tall; little color
- Type of greenery at the corner--can't see traffic at most stop signs
- Do not like how they protrude into the street and make the street narrower
- Placement that extends into roadway
- Flowers don't grow, plants uneven, ugly bushes

- The rusty metal is not ideal
- Ugly
- I dislike some of the plants are over the sidewalk
- Plant selection is poor and unattractive, some sites are maintained better than others
- Looks country, ghetto, taks up space, a place for people to drive by and throw trash in
- Need more safety barriers on corners
- They drop everything as they pass by, the emplty pop bottles or cans, their empty food containers, just anything. It's disgusting.
- Takes awhile to drain
- Some of the plants are dead--not suitable for all day sun
- I was originally given rain garden plants that had much nore attractive plants; Plants very blah!; The posts are ugly and have been knocked down several times by cars; trash thrown into the rain gardens by people. Also trash blows into the rain gardens. Wads of toilet paper were in the rain gardens several weeks ago; even people in wheelchairs usually use the street instead of the sidewalk. All my input was treated as unimportant. Feedback was only supposed to be positive feedback apparently.

9. Over the past year, have you noticed a change in the amount of loose trash and litter in your neighborhood?

Response	*%*	*Response options*
1	5%	Much higher
3	14%	Somewhat higher
9	41%	About the same
6	27%	Somewhat lower
3	14%	Much lower
0	0%	I have not noticed
22		Total responses

10. Since more sidewalks have been added or repaired during the pilot project, have you observed more people using the sidewalks on your street or elsewhere in the neighborhood?

Response	*%*	*Response options*
12	55%	Yes
10	45%	No
22		Total responses

11. If the project started over again, what ONE THING would you most like to provide input on?

Response	*%*	*Response options*
5	22%	Location of streetside rain gardens
8	35%	Types of plants used
4	17%	Rain garden reflector posts
2	9%	Locations of repairs to curbs, streets, or sidewalks
4	17%	Other: Not to protrude into the streets; replanting grass and tree removal; basin design; take rain gardens out
23		Total responses

12. What is your least favorite part of the rain gardens that have been installed?

Response	%	Response options
8	28%	Appearance of the plants
7	24%	Reflector posts
6	21%	Depth of rain gardens
5	17%	Accumulation of trash and litter
3	10%	Other: Cleaning; more bugs and plants are dead
29		Total responses

13. What do you think is the BEST improvement thatwas made as a result of the pilot project?

Response	%	Response options
7	18%	Sewer system improvements
11	29%	Sidewalk improvements in some locations
9	24%	Installation/repair of curbs in some locations
5	13%	Rain gardens/green infrastructure
6	16%	Street resurfacing in some locations
38		Total responses

14. How likely are you to install and maintain a rain garden on your property?

Response	%	Response options	
5	24%	Very likely	5
1	5%	Likely	1
4	19%	Unsure	3
6	29%	Unlikely	5
5	24%	Very unlikely	2
21		Total responses	

15. Other comments:

- Senior citizens unable to maintain
- We took a risk moving east of Troost and are overjoyed that efforts are being made to improve the area!
- Some plants look good, others grow up like weeds
- Unsure if I will install rain garden: I'm too old and have lower back, shoulders, ankle, hip and knee problems
- Resident input was not screened!
- _____ and _____ have disrespected my opinions. I have ben treated rudely thoughout the process.
- I think the changes have encouraged more people to stay in or move to the neighborhood
- My neighbor blows his cut grass into the street and clogs my basin!
- No sidewalk improvements, cheap street repair [resident north of 75th Street]
- The rain gardens are too deep and unsafe for my age to climb down and get trash, turned my ankle once won't try it again
- The city took domain of property with the promise of improved appearance and value and nothing could be further from the truth. Some areas seemed to be controlled by doing the least expensive work possible. Damage to existing sidewalks were never repaired. For the residents that had already paired [paid?]for new sidewalks, curbs and parkways and had newly paved streets...this project destroyed all of those investments. [All improvements were within the public ROW]
- Has been a HUGE improvement for the urban core

Appendix B

Landscape Architecture Foundation

2016 Landscape Performance Case Study: "Middle Blue River Basin Green Solutions Pilot Project"

Comparison of Housing Values Between Middle Pilot Project Area and Control Area

Housing value estimates compiled from Zillow.com by Jim Schuessler; Summary and Analysis by Howard Hahn

Indicates addresses with a BMP

Indicates addresses not included due to excessive SF or distressed sale

Address	Square Feet	Last Sold Price	Year Last Sold	11/12/2012 Zestimate	2/1/2015 Zestimate	8/1/2016 Estimate	2012-2016 % Change	Notes
1336 E. 75th Street	1,475	$ 41,900	2015	$ 51,000	$ 40,000	$ 55,413	8.7%	No historical data
		$ 19,000	2014					
		$ 42,433	2010					Foreclosure
1405 E. 75th Street	1,521	$ 58,900	2016	$ 64,000	$ 34,000	$ 54,386	-15.0%	No historical data
		$ 23,500	2008					
		$ 56,000	2008					Foreclosure
1134 E. 75th Terr.	1,234	$ 20,100	2014	$ 69,000	$ 37,000	$ 53,446	-22.5%	
		$ 46,837	2014					Foreclosure
1420 E. 75th Terr.	1,242	$ 55,000	2007	$ 59,000	$ 30,000	$ 52,328	-11.3%	No historical data
		$ 73,304	2007					Foreclosure
1424 E. 75th Terr.	1,321	$ -	NA	$ 60,000	$ 30,000	$ 52,628	-12.3%	No historical data
1426 E. 75th Terr.	774	$ 29,000	2014	$ 46,000	$ 28,000	$ 46,570	1.2%	
		$ 130,000	2010					
		$ 34,900	2006					
1449 E. 75th Terr.	2,079	$ -	NA	$ 94,000	$ 32,000	$ 77,335	-17.7%	No historical data
1122 E. 76th Street	1,474	$ 10,801	2011	$ 77,000	$ 48,000	$ 59,478	-22.8%	Foreclosure
		$ 87,000	2005					
1218 E. 76th Street	2,878	$ 66,500	2016	$ 120,000	$ 31,000	$ 76,396		
		$ 45,000	2009					
1320 E. 76th Street	1,226	$ 65,000	2005	$ 57,000	$ 65,000	$ 54,687	-4.1%	
1321 E. 76th Street	1,192	$ 76,500	2004	$ 49,000	$ 28,000	$ 54,169	10.5%	
1324 E. 76th Street	1,729	$ -	NA	$ 64,000	$ 34,000	$ 58,070	-9.3%	No historical data
1325 E. 76th Street	832	$ 15,000	2006	$ 46,000	$ 28,000	$ 51,201	11.3%	
1336 E. 76th Street	1,628	$ 84,409	2012	$ 70,000	$ 33,000	$ 56,820	-18.8%	Foreclosure
1337 E. 76th Street	1,064	$ 25,075	2011	$ 43,000	$ 28,000	$ 51,504	19.8%	Foreclosure
1340 E. 76th Street	1,397		2015	$ 68,000	$ 30,000	$ 56,602	-16.8%	
1512 E. 76th Street	1,120		2016	$ 49,000	$ 29,000	$ 50,823	3.7%	
915 E. 76th Terr.	1,325	$ 95,000	2013	$ 96,000	$ 116,000	$ 119,775	24.8%	
1111 E. 76th Terr.	866	$ 34,500	2011	$ 67,000	$ 38,000	$ 54,843	-18.1%	Foreclosure
1112 E. 76th Terr.	972	$ -	NA	$ 68,000	$ 41,000	$ 56,539	-16.9%	No historical data
1115 E. 76th Terr.	1,598	$ -	NA	$ 96,000	$ 43,000	$ 63,623	-33.7%	No historical data
1119 E. 76th Terr.	1,031	$ 15,000	2009	$ 67,000	$ 39,000	$ 59,488	-11.2%	Foreclosure
1122 E. 76th Terr.	1,453	$ 82,000	2015	$ 72,000	$ 42,000	$ 59,558	-17.3%	
1126 E. 76th Terr.	1,080	$ -	NA	$ 68,000	$ 42,000	$ 57,489	-15.5%	No historical data
1130 E. 76th Terr.	1,042	$ -	NA	$ 63,000	$ 40,000	$ 56,957	-9.6%	No historical data
1136 E. 76th Terr.	1,973	$ 37,121	1998	$ 95,000	$ 50,000	$ 76,631	-19.3%	Foreclosure
1140 E. 76th Terr.	1,649	$ -	NA	$ 73,000	$ 43,000	$ 64,004	-12.3%	No historical data

1141 E. 76th Terr.	790	$ -	NA	$ 40,000	$ 34,000	$ 59,481	48.7%	No historical data
1145 E. 76th Terr.	924	$ 18,000	2009	$ 36,000	$ 34,000	$ 62,789	74.4%	
		$ 30,000	2008					
1155 E. 76th Terr.	1,004		2016	$ 50,000	$ 28,000	$ 70,223	40.4%	
1160 E. 76th Terr.	1,177	$ 73,250	2015	$ 51,000	$ 28,000	$ 62,509	22.6%	
		$ 65,000	2005					
1163 E. 76th Terr.	751	$ 42,957	2012	$ 47,000	$ 28,000	$ 65,419	39.2%	Foreclosure
		$ 59,800	2004					
1400 E. 76th Terr.	840	$ 55,000	2009	$ 61,000	$ 34,000	$ 51,581	-15.4%	
1425 E. 76th Terr.	1,513	$ 5,000	2016					Foreclosure
1428 E. 76th Terr.	1,940	$ 40,000	2005	$ 69,000	$ 45,000	$ 71,246	3.3%	
1434 E. 76th Terr.	1,084	$ 82,680	2007	$ 47,000	$ 28,000	$ 50,315	7.1%	
1438 E. 76th Terr.	1,084	$ 32,400	2008	$ 44,000	$ 28,000	$ 47,825	8.7%	
		$ 101,700	2008					Foreclosure
1459 E. 76th Terr.	1,005	$ -	2001	$ 48,000	$ 33,000	$ 54,133	12.8%	No historical data
1460 E. 76th Terr.	987	$ -	NA	$ 34,000	$ 29,000	$ 48,068	41.4%	No historical data
1462 E. 76th Terr.	888	$ -	NA	$ 34,000	$ 30,000	$ 49,460	45.5%	No historical data
1467 E. 76th Terr.	907		2016	$ 45,000	$ 37,000	$ 66,351	47.4%	
1464 E. 76th Terr.	1,483	$ -	NA	$ 63,000	$ 36,000	$ 56,799	-9.8%	No historical data
1471 E. 76th Terr.	1,471	$ -	NA	$ 52,000	$ 54,000	$ 79,992	53.8%	No historical data
West Side of Troost								
845 E. 77th Street	1,764	$ -	2006	$ 131,000	$ 131,000	$ 133,442	1.9%	No historical data
901 E. 77th Street	1,944	$ 135,000	2016	$ 139,000	$ 135,000	$ 134,727	-3.1%	
929 E. 77th Street	1,326	$ 22,214	2012	$ 38,000	$ 96,000	$ 104,419	174.8%	Foreclosure
		$ 90,000	2009					
		$ 60,133	2003					Foreclosure
North / South Road								
7409 Flora Ave.	1,578	$ 21,000	2010	$ 59,000	$ 37,000	$ 51,474	-12.8%	
7412 Flora Ave.	1,822	$ -	NA	$ 69,000	$ 42,000	$ 56,027	-18.8%	No historical data
7416 Flora Ave.	1,924	$ -	NA	$ 69,000	$ 44,000	$ 62,655	-9.2%	No historical data
7419 Flora Ave.	1,024	$ -	NA	$ 52,000	$ 36,000	$ 45,955	-11.6%	No historical data
7421 Flora Ave.	1,458	$ 36,520	2010	$ 63,000	$ 37,000	$ 51,575	-18.1%	
7434 Flora Ave.	1,574	$ -	1998	$ 50,000	$ 37,000	$ 52,700	5.4%	No historical data
7439 Flora Ave.	1,200	$ 32,000	2014	$ 48,000	$ 37,000	$ 49,144	2.4%	
		$ 35,000						Foreclosure
7445 Flora Ave.	1,482	$ -	NA	$ 43,000	$ 37,000	$ 49,058	14.1%	No historical Data
7446 Flora Ave.	1,376	$ 21,500	2009	$ 47,000	$ 36,000	$ 50,479	7.4%	
		$ 100,000	2006					
North / South Road								
7345 Lydia Ave.	1,092	$ -	2002	$ 63,000	$ 33,000	$ 43,344	-31.2%	No historical data
7400 Lydia Ave.	862	$ -	NA	$ 36,000	$ 34,000	$ 42,272	17.4%	No historical data
7409 Lydia Ave.	1,621	$ 32,515	2010	$ 51,000	$ 40,000	$ 52,643	3.2%	
		$ 51,470	2005					

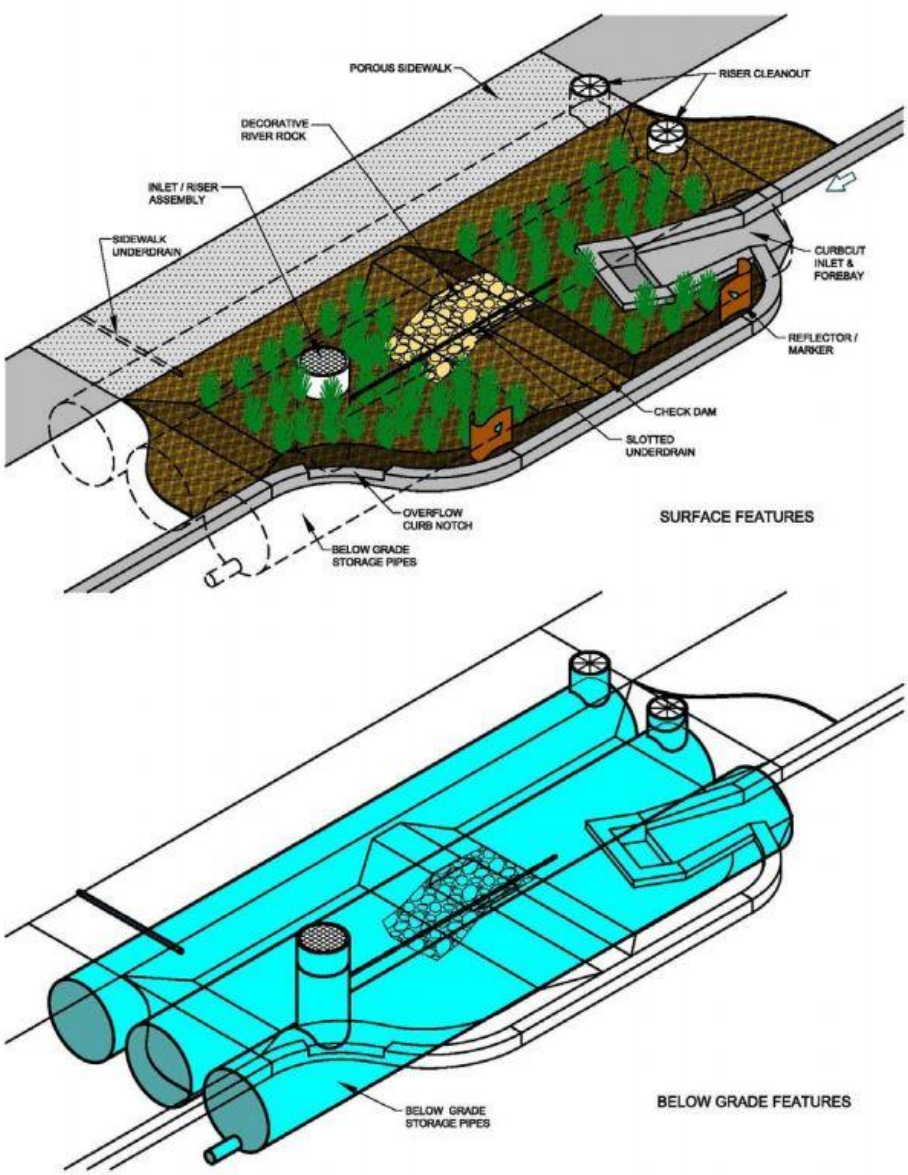
					2012-2016 % Change	
SUMMARY	**Avg. SF**	**11/12/2012 Zestimate**	**2/1/2015 Zestimate**	**8/1/2016 Estimate**	Avg per Parcel % Change	% Change of Column Avg.
Average: All 56 homes	**1,311**	**$ 61,309**	**$ 41,273**	**$ 60,474**	**2.6%**	**-1.36%**
Avg per SF		$ 46.75	$ 31.47	$ 46.11		-1.36%
Avg: 28 Homes w/ BMP	**1,273**	**$ 55,964**	**$ 35,714**	**$ 54,549**	**1.1%**	**-2.53%**
Avg per SF		$ 43.98	$ 28.06	$ 42.86		-2.53%
Avg: 28 Homes no BMP	**1,332**	**$ 64,464**	**$ 45,357**	**$ 64,239**	**4.0%**	**-0.35%**
Avg: per SF		$ 48.41	$ 34.06	$ 48.24		-0.35%

FOR COMPARISON - 2 blocks south

Address	SF	Last Sold Price	Last Sold Year	11/12/2012 Zestimate	2/1/2015 Zestimate	8/1/2016 Zestimate	2012-2016 % Change	Notes
1125 E 77th Terrace	1,586		2005	$ 78,000	$ 41,000	$ 58,144	-25.5%	
1126 E 77th Terrace	1,542	$ 96,900	2004	$ 75,000	$ 42,000	$ 58,854	-21.5%	
1147 E 77th Terrace	1,206			$ 67,000	$ 39,000	$ 54,229	-19.1%	No historical data
1148 E 77th Terrace	1,771	$ 26,835	2010	$ 64,000	$ 42,000	$ 57,790	-9.7%	Foreclosure
1164 E 77th Terrace	1,747			$ 71,000	$ 41,000	$ 59,833	-15.7%	No historical data
1187 E 77th Terrace	1,330			$ 67,000	$ 39,000	$ 55,039	-17.9%	No historical data
1423 E 77th Terrace	1,448			$ 63,000	$ 43,000	$ 54,466	-13.5%	No historical data
1116 E 78th Street	1,187			$ 71,000	$ 29,000	$ 52,771	-25.7%	No historical data
1120 E 78th Street	1,488			$ 95,000	$ 42,000	$ 60,863	-35.9%	No historical data
1125 E 78th Street	1,406			$ 75,000	$ 41,000	$ 57,345	-23.5%	No historical data
		$ 40,000	2009					Foreclosure
1156 E 78th Street	1,087		2015	$ 65,000	$ 39,000	$ 54,069	-16.8%	
		$ 87,000	2005					
1160 E 78th Street	1,016			$ 65,000	$ 39,000	$ 53,998	-16.9%	No historical data
1168 E 78th Street	1,352			$ 63,000	$ 38,000	$ 54,642	-13.3%	No historical data
1319 E 78th Street	1,442	$ 50,000	2016	$ 45,000	$ 42,000	$ 54,511	21.1%	
1406 E 78th Street	1,539			$ 72,000	$ 57,000	$ 59,624	-17.2%	No historical data
1410 E 78th Street	1,824	$ 61,345	2013	$ 85,000	$ 63,000	$ 60,757	-28.5%	
1440 E 78th Street	1,720	$ 37,536	2015	$ 70,000	$ 33,000	$ 55,671	-20.5%	
		$ 67,500	2007					Foreclosure
		$ 89,885	2006					
		$ 103,000	2004					
1124 E 79th Street	900			$ 61,000	$ 28,000	$ 50,704	-16.9%	No historical data
1305 E 79th Street	1,700			$ 66,000	$ 50,000	$ 51,918	-21.3%	No historical data
1416 E 79th Street	1,638			$ 57,000	$ 41,000	$ 52,331	-8.2%	No historical data

					2012-2016 % Change	
SUMMARY	Avg. SF	11/12/2012 Zestimate	2/1/2015 Zestimate	8/1/2016 Estimate	Avg per Parcel % Change	% Change of Column Avg.
Average: 20 homes	**1,446**	**$ 68,750**	**$ 41,450**	**$ 55,878**	**-17.3%**	**-18.70%**
Average per SF		$ 47.53	$ 28.66	$ 38.63		-18.70%

Appendix C



"Curb Extension Surface and Below Grade Features" (Source: Kansas City Water Services Department. 2012. *Middle Blue River Basin Green Solutions Pilot Project Operations and Maintenance Manual.*)