Uptown Normal Circle and Streetscape – Normal, IL
Methodology for Landscape Performance Benefits

Environmental

- ***Saves $7,600 annually in potable water costs by capturing 1.4 million gallons of stormwater from a 58,800 sf area and reusing it in the water feature and for irrigation.***

The surface area which drains into the 75,000 gallon underground cistern (parts of Constitution Trail and East Beaufort Street) is 58,806 square feet (as provided by Hoerr Schaudt). Multiplying this area by average annual rainfall in feet provides an approximation of the volume of water collected in the cistern each year. This is also the number of gallons prevented from entering the storm sewer system each year. The NOAA's National Climatic Data Center (NCDC) 1981-2010 Climate Normals show that the average annual precipitation at Normal, IL (station number USC00116200) is 39.34 inches (ftp://ftp.ncdc.noaa.gov/pub/data/normals/1981-2010/products/station/USC00124244.normals.txt, retrieved 7-21-2011 by Robin L. Burke). Monetary savings of $5.40 per 1,000 gallons (the price of potable water in Normal, IL) are calculated, assuming that all the captured stormwater is used for the fountain and irrigation--without which, potable water would have to be used. Calculations are as follows:

> Surface area that drains into cistern (Constitution Trail and E. Beaufort streets): 58,806 sf
> Total project area = 212,223 square feet
> (58,806 / 212,223) x 100 = 27.7% of site drains into cistern
>
> Annual rainfall in Normal: 39.34 inches = 3.28 feet
> Volume of water draining to underground cistern: 3.28 ft x 58,806 sf = 192,883.68 cubic feet, or 1,442,866 gallons per year
>
> Cost of potable water: $5.40 per 1000 gallons
> 1,422,866 gal / 1,000 = 1,442
> 1,442 x $5.40 = $7,683 per year

- ***Prevents an additional 1.4 million gallons of stormwater from entering the municipal storm sewer by directing runoff from sidewalks into tree wells and planter areas augmented by underground structural cells. This also recharges groundwater.***

The Sidewalk areas that drain into structural cells below tree wells and planting areas were measured in AutoCAD by importing pdf's of the construction documents LS1.1 - LS1.9 (provided by Rob Gray of Hoerr Schaudt). These construction documents show where structural cells are located; sidewalk area adjacent to or nearby structural cells was measured, excluding where sloped curb ramps would channel water away from the structural cells. The NOAA's National Climatic Data Center (NCDC) 1981-2010 Climate Normals show that the average annual precipitation at Normal, IL (station number USC00116200) is 39.34 inches (ftp://ftp.ncdc.noaa.gov/pub/data/normals/1981-2010/products/station/USC00124244.normals.txt, retrieved 7-21-2011 by Robin L. Burke).

> Sidewalk area draining to Silva Cells: 58,751 square feet
> Annual rainfall in Normal: 39.34 inches = 3.28 feet per year
> Volume of water draining to Silva Cells: 58,751 sf x 3.28 ft = 192,703 cubic feet, or **1,441,516 gallons per year**

Because the soil within the Silva Cells is not compacted and occupies 40,200 cubic feet underground, the features infiltrate more water than would be possible in a conventional small street-tree planting area. Sixty-seven of the trees on-site are planted with Silva Cells; the roots of each tree have access to 600 cubic feet of uncompacted soil (http://www.deeproot.com/deeproot_form/index.php?scpdf=caseStudies/Normal%20IL%20Streetscape_New, accessed 6-16-2011). This same volume of soil provides underground storage for water that runs off from sidewalks. The calculation providing total soil volume available to tree roots and for runoff storage is below:

67 trees x 600 cubic feet of soil per tree = **40,200 cu ft of soil in Silva Cells**

- ***Improves water quality in the fountain by removing an estimated 91% of total suspended solids, 79% of total phosphorous, and 64% of total nitrogen from stormwater with each pass through the sand, UV, and bog filter system.***

The loading of pollutants from the 1.35 acres of road that drain into the underground cistern (and subsequently pass through an underground sand filter followed by a pocket marsh) was calculated by multiplying the loading (drainage acreage x pounds of pollutant per acre per land use per year, multiple sources below) by the percent expected removal by a filtration feature as reported by Randolph (2004). This calculation was first done for the underground sand filter. The remaining weight of each pollutant was then multiplied by the percent removed by passage through a pocket marsh. The total weight of pollutant removed was then used to calculate the total percentage of each pollutant removed. Once runoff water enters the fountain and filtration system, it may cycle through it several times. Note that the percent removal of pollutants reported here is per cycle through the filtration system.

Surface area that drains into cistern (Constitution Trail and E. Beaufort streets): 58,806 sf
58,806 square feet = 1.35 acres

Pounds of phosphorus generated per acre of road: 0.8
1.35 acres of road x 0.8 pounds phosphorous per acre = 1.08 pounds phosphorous
Underground sand filter removes 50% of phosphorous = 1.08 lbs x 0.50 = 0.54 lbs phosphorous removed
Pocket marsh removes 57% of remaining phosphorous = 0.54 lbs x 0.57 = 0.31 lbs phosphorous removed
Total phosphorous removed = 0.54 lbs + 0.31 lbs = 0.85 lbs
Percent phosphorous removed = (0.85 lbs / 1.08 lbs) x 100 = **78.5%**

Pounds of nitrogen generated per acres of road: 7.0
1.35 acres of road x 7 pounds nitrogen per acre = 9.45 pounds nitrogen
Underground sand filter removes 35% of nitrogen = 9.45 lbs x 0.35 = 3.31 lbs nitrogen removed
Pocket marsh removes 44% of remaining nitrogen = 6.14 lbs x 0.44 = 2.70 lbs phosphorous removed
Total nitrogen removed = 3.31 lbs + 2.70 lbs = 6.01 lbs
Percent phosphorous removed = (6.01 lbs / 9.45 lbs) x 100 = **63.6%**

Tons of total suspended solids (TSS) generated per acre of road: 0.14
1.35 acres of road x 0.14 tons TSS per acre = 0.189 tons TSS
Underground sand filter removes 80% of TSS = 0.189 tons x 0.80 = 0.15 tons TSS removed
Pocket marsh removes 57% of remaining phosphorous = 0.038 tons x 0.57 = 0.03 tons TSS removed
Total TSS removed = 0.15 tons + 0.03 tons = 0.17 tons
Percent phosphorous removed = (0.17 tons / 0.189 tons) x 100 = **91.4%**

References
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Randolph, J. 2004. Environmental Land Use Planning and Management. Island Press, Washington, D.C.

Steuer, J., W. Selbig, N. Hornewer, and J. Prey. 1997. Sources of Contamination in an Urban Basin in Marquette, Michigan and an Analysis of Concentrations, Loads, and Data Quality. U.S. Geological Survey, Water-Resources Investigations Report 97-4242.

- ***Sequesters at least 10,790 pounds of carbon annually in 104 new trees.***

Carbon sequestration was calculated using the National Tree Benefits Calculator (treebenefits.com, accessed on 7/5/2011 by Sarah Alward) by entering the caliper measurements from the construction documents provided by Hoerr Schaudt. The calculator requires input of diameter at breast height (DBH) while tree size at installation was reported in the construction documents by caliper-- also a trunk diameter measurement, but taken at a different height. In order to make use of the calculator, which provides estimations rather than precise data, caliper measurements were entered for the DBH field. (See methods for Benefit above for a list of tree species and caliper measurements at installation.)

This rate of carbon sequestrations is roughly equivalent to taking one car off the road each year, based the National Tree Benefits Calculator, which assumes the average mid-sized sedan drives 12,000 miles a year and emits 11,000 pounds of carbon annually. Sequestration should increase over time as the trees grow.

Social

- ***Expected to reduce traffic accidents by 35% by replacing an awkward intersection with a roundabout containing 75% fewer points of conflict than a conventional 4-way intersection.***

The National Cooperative Highway Research Program (NCHRP) indicates that roundabouts reduce accidents by 35% at intersections where stop signs or signals were previously used for traffic control.
NCHRP Report 572: Roundabouts in the United States. National Cooperative Highway Research Program, TRB, NAS, Washington, DC, 2007.

Economic

- ***Saves $61,000 in tree purchase and installation costs over 50 years by more than tripling the expected lifespan of street trees from 13 to 50+ years through the use of underground structural cells.***

DeepRoot (the manufacturer of the Silva Cells used in this project) conducted a life cycle cost analysis of trees planted in 1,000 cubic feet of soil in Silva Cells as compared to traditional urban trees in a 4'x4'x4' tree pit surrounded by pavement, providing 64 cubic feet of uncompacted soil (The Kestrel Design Group). The analysis modeled life cycle costs and benefits of 50 years using i-tree, a peer-reviewed tool providing costs and benefits of urban forestry from the USDA Forest Service. The 13-year average life span of a traditional urban tree was based on a 1992 paper by Skiera and Moll (1992). The Kestrel Design Group Life Cycle Cost Analysis reports that the initial investment of $14,000 to install a tree with Silva Cells is paid back in ecological benefits 21 years after installation, with over $25,000 in additional benefits paid back by the tree 50 years after installation (p. 8).

A total of 67 trees were planted in Silva Cells. If these were instead planted traditionally and would require replacement two or three times over 50 years, 191 replacement trees would be needed. The calculation is below:

(50 years) - (initial 13-year lifespan of installed tree) = 37 years
(37 years) / (13-year life spans) = 2.85 average replacements
2.85 x 67 trees = 190.95 replacement trees needed

The cost of replacing and installing 191 trees was found using RSMeans CostWorks online construction estimator (http://www.meanscostworks.com/, requires registration). When the precise species and size of tree planted in Normal was not available in RSMeans CostWorks, a close approximation was made; species and approximate sizes entered in RSMeans are listed below. Assuming all types of trees fare equally well, and need to be replaced in the same proportions in which they were planted, the following trees will be needed in the next 50 years:

Actual installed trees:
Autumn Blaze Freeman Maple, 4" caliper, 35' h x 20'. Qty: 16 (Acer x freemanii 'Autumn Blaze')
Bloodgood London Planetree, 4" caliper, 30'h x 20's. Qty: 12 (Plantinus x acerifolia 'Bloodgood')
Swamp White Oak, 4" caliper, 40'h x 50s, Qty: 27 (Quercus bicolor)
Frontier Elm, 4" caliper, 40'h x 25s, Qty: 21 (Ulmus x 'Frontier')
Triumph Elm, 4" caliper, 50'h x 40's, Qty: 28 (Ulmus x 'Triumph')

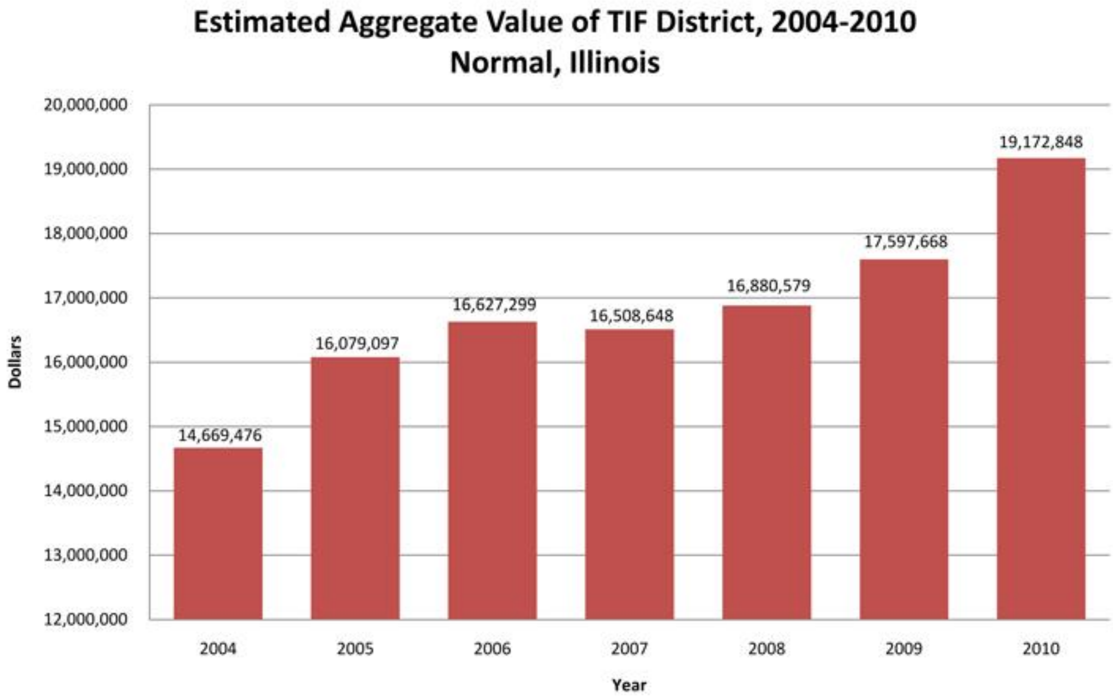
Approximations entered in RSMeans CostWorks:
Red maple, 2.5-3 caliper: 29
American Sycamore, 3-3.5 caliper: 22
White Oak family, 4-4.5 caliper: 50
American elm, 6-8': 90

Total cost for installation and 191 plants: **$60,711**

References:
Kestrel Design Group, Investment vs. Returns for Healthy Urban Trees: Life Cycle Cost Analysis, page 2. http://www.deeproot.com/silvapdfs/resources/articles/LifecycleCostAnalysis.pdf, accessed 6/16/11.
Skiera, B. and Moll, G. 1992. The Sad State of City Trees. American Forests. March/April: 61-64.

- ***Increased property values in the Uptown tax increment financing district by $1.5 million (or 9%) from 2009 to 2010, a 31% increase from 2004.***

The estimated aggregate values (EAV) of properties within the tax increment financing (TIF) district from 2004 to 2010 was used to track the changes in property values. The EAV report was provided by Wayne Aldrich, the Uptown Development Director (7/2011).



Year	Estimated Aggregate Value	Percent change year to year	Percent change since 2004
2004	14,669,476		
2005	16,079,097	10	10
2006	16,627,299	3	13
2007	16,508,648	-1	13
2008	16,880,579	2	15
2009	17,597,668	4	20
2010	19,172,848	9	31

- ***Generated more than $680,000 of revenue through conferences held in Normal that featured the Uptown Redevelopment.***

Personal communication with Heather VanVoorhis at the Bloomington-Normal Marriott indicated that there have been four professional conferences (and one scheduled for 2012) that have been held in Normal because of the completion of the traffic circle (AIA Illinois Chapter, Illinois Association for Floodplain and Stormwater Management, Illinois Association of Wastewater Agencies, Illinois City/County Management Association, and Illinois Chapter American Planning Association). By contacting these organizations to report attendance and registration fees, the approximate amount of revenue generated was determined:

> Number of participants x registration fees
> + cost of hotel rooms (assuming $119 per night per person, the conference rate)
> + a $46 per diem per day (based on the federal per diem rate for Illinois)

For these four conferences, the estimated revenue generated totals **$681,398.**