LANDSCAPE PERFORMANCE SERIES

Advocate Lutheran General Hospital Patient Tower – Park Ridge, IL
Methodology for Landscape Performance Benefits
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Environmental

Prevents or slows approximately 90% of site's annual stormwater runoff from entering the municipal storm sewer system, managing stormwater volumes up to 309,000 gallons of water in a single event.

The entire site is designed to capture, filter, detain and/or retain stormwater through green roofs, permeable pavements, raingarden planters, bio-infiltration gardens, an underground stone-reservoir, and a final surface detention area. Each feature is designed to provide a visible, understandable design strategy for managing stormwater. Each feature contributes in varying ways through infiltration, conveyance, storage and/or evapotranspiration processes.

Stormwater modeling by the civil engineer showed that regarding infiltration and evaporation, the system would have zero discharge up to nearly a 1.0 inch rainfall. Further, for a 2-year rainfall of 3.04 inches, the site was calculated to produce only 0.58 inches of runoff for an effective volumetric runoff coefficient of 0.19 for the 2-year event. (GHA, January 20, 2006) According to the site's civil engineer, on an annual basis, the site can be expected to reduce runoff volumes by nearly 90% relative to a fully impervious site. (Price, August 12, 2013)

To satisfy differing sets of stormwater requirements (water reclamation district, and local municipality), the site has two (somewhat redundant) systems of storage designed into it: one to provide subsurface storage (preferred by the client and design team) for reasons of site usability, and one above-grade detention area, constructed to satisfy Metropolitan Water Reclamation District (MWRD) stormwater requirements at that time that would not allow detention in below grade gravel storage. Because of the increased capacity, the design has proven to exceed stormwater management requirements and goals. Greg Sheehan, site manager for the Bed Tower site stated that the largest recent storms, lasting 5 days in April 17-22 filled the above-grade basin to just below the elevation of the sidewalk. (Greg Sheehan, May, 2013) The system is designed to hold such storm volumes over a period of days to slow release into the municipal system and/or evaporate and infiltrate.

HOLDING CAPACITY:
Total holding capacity of the site is 0.95 acre-feet. Permitting to satisfy the two storage systems is summarized as:

- MWRD requirement is for .47 acre-feet, and is provided primarily in the Basin 7 (above-ground detention area of the spiral garden). (GHA, January 16, 2006)
- Park Ridge requirement is for .73 acre-feet, and is provided through 7 basins of varying size, including planting areas, all underlain with the underground stone-reservoir leading to the Basin 7 spiral garden, designed for overflow storage when the storage in the permeable paving and rain garden system is full. (GHA, January 20, 2006)

In the northeastern Illinois region, over 90% of the rainfall events are less than 1.0 inches. Although the site has poor soils for infiltration, the large area available for infiltration combined with the evapotranspiration that occurs due to the significant plantings in the stormwater system have been calculated to fully retain up to a 1.0 inch rainfall event with zero discharge. (Price, August 12, 2013)

Storms with rainfall exceeding 1.0-inch are detained and slowly released to the City storm sewer system. Depending on the storm volume this release rate and time will vary. Restrictors for all site basins are sized at 1.1 inches to satisfy a Park Ridge allowable release rate of 0.45cfs for the 100-year event.

The site is an exemplar of providing multiple methods for stormwater management and holding capacity, allowing only the larger storm events to release into the sewer system, but only over a period of days, with the majority of the storm contained within the reservoir and detention basin.

Sources:
Gewalt Hamilton Associates (GHA) “MWRDGC Sewerage System Permit”, January 16, 2006

Gewalt Hamilton Associates (GHA) “Stormwater Management Narrative” and “Detention Calculations, City of Park Ridge Criteria”, January 20, 2006

Huff, F. A., and J. R. Angel, Rainfall Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois (Bulletin 70), Illinois State Water Survey, 1989.

Price, Tom, “Advocate Lutheran General Hospital_Final Draft Methods_20130812-TP” August 12, 2013

Price, Tom, Conversations and interviews held May-August, 2013

Sheehan, Greg, Advocate Healthcare site tour, May, 2013

Removes at least 80% of total suspended solids by treating at least 90% of average annual rainfall using green roofs, bio-infiltration, and permeable paving.

LEED submittal documentation indicates that Stormwater Management: Quality Control was met for Credit 6.2 -Version 2.2. Application material completed by Robert Hamilton of Gewalt Hamilton Associates in 2007 for Credit 6.2 documented compliance that “The stormwater run-off from 90% of the average annual rainfall is captured or treated such that 80% of the average annual post-development Total Suspended Solids (TSS) is removed.” Documentation listed non-structural controls of:

Non-Structural Controls

Best Management Practices (BMP)	Description of BMP's Contribution to Stormwater Filtration	Percent of Annual Rainfall Volume Treated by BMP (%)
Green Roof	Treats runoff from 47 percent of the roof area. Since all rainfall onto the roof filters through the green roof media, TSS removal will exceed 95%	98.0
Blofiltration rain garden	Treats runoff from 100 % of the roof, 60% of the porous pavement, and adjacent impervious area (including green roof, permeable paving and conventional paving). Since all rainfall onto the roof filters through the green roof media, TSS removal will exceed 95%	98.0
Permeable paving	Treats all rainfall from all permeable paving areas. Using gravel filters as a comparison, TSS removal is expected to be 80%	90.0

The USGBC Construction Application Review of March 23, 2010 confirmed that “The LEED Submittal Template has been provided indicating that the stormwater management system (including vegetated

roof, bioswales, and pervious pavement) removes at least 80% of TSS (Total Suspended Solids) by treating at least 90% of average annual rainfall."

Eliminates the need for irrigation with potable water by utilizing drought-tolerant, native and adapted plant species and by conveying stormwater for passive irrigation.

The site is designed to capture and hold stormwater, as a passive irrigation design strategy. All areas are graded to absorb and infiltrate stormwater to the highest degree possible. Plant selections are native/adapted and drought-tolerant, designed for periods of drought, and do not require supplemental irrigation beyond the initial establishment period. Important to the landscape as part of the public realm, is that the design of rainwater is kept visible and celebrated, providing examples of how to design sustainable storm water features and planting in an urban environment.

Documentation of this achievement is confirmed in the 2007 submittal documentation for LEED WE Credit 5.1-5.2 2007 narrative:
"SS Criterion 2 has been achieved by the project. The site open space includes extensive and semi-intensive green roofs (23,280 s.f. (Sheet L 6.0 and Specifications 02940 and 02945), vegetated areas that include rain gardens and landscaped areas (41,277 s.f.) and pedestrian or landscape-related hardscape (22, 048 s.f.) (Sheets L 3.1 and 3.2). The landscape is designed to eliminate both turf and the need for irrigation. All plant selections have been made from indigenous species or cultivars of native species, or species that are adapted to the proposed conditions that will survive after they are established without extensive inputs of water, fertilizer, etc. The extensive green roof includes a mix of sedums and native grasses and wildflowers. The semi-intensive green roof includes a similar mix of sedums and native grasses, sedges and wildflowers (Specification 02945)."

The elimination of irrigation is further confirmed wherein the project scored 2 points for *Option 4: The landscaping installed does not require permanent irrigation systems. Temporary irrigation systems used for plant establishment will be removed within one year of installation.*

Supporting excerpts from the narrative describe the organization of the landscape to collect and/or convey to collection areas:
"Sheets L 1.1 and 3.1 include layout and planting design for the main entrance landscape which includes planted rain gardens adjacent to the main entrance, an abstracted low "prairie" planting and rain gardens opposite the main entrance drive and next to an existing parking deck, and a terraced planting that makes up the difference in grade between the entrance drive and Dempster Avenue to the north. In addition, a semi-intensive green roof is planned [is constructed] above the connecting hallway that leads west to east immediately south of the planters shown on L 1.1. Water from the green roof is collected by rain chains that transfer runoff from this green roof to the series of planters in front of the windows.

Water runoff from a section of the non-green roof area of the new bed tower is collected by a stainless steel runnel that outlets on the southwest corner of the new tower and distributes the water to Rain Garden 1 (L1.1). This runnel diverts water to 4 stone channels that divide the rain garden into 5 sections. As the channels fill, the overflow spills into the rain garden. Rain Garden 1, like all others in the design, is underlain with open-graded gravel (CA 7) that is contiguous with that laid under the permeable pavement of the hospital drive. As water drains through the planting it is cleansed and cooled. Rain Garden 1 is planted ornamentally with a mix of native and non-native adapted species (L3.1). Based on the CA 7 layer under all rain gardens, the planting design assumes these areas will be fairly dry. Once established, this collected rainwater and that which falls on this surface will be the only sources of water

for these spaces. The small rain gardens opposite the entrance, Rain Gardens 9 and 10, are designed to collect any runoff that may occur from the permeable pavement.

Rain Garden 2 receives water from a portion of the bed tower roof that includes a mix of extensive green and non-green surfaces. Water is transmitted to the garden via a covered trench drain, north to a stone-filled channel that outlets through Retaining Wall 2 and spills to the garden. This trench drain is the first of a series of 4 that collect roof water and distribute it to a series of terraced rain gardens on both sides of the entrance drive. The fifth, or easternmost trench drain, receives any overflow from Rain Garden 8.

Approximately 17,495 s.f. (+/_ 64%) of the Bed Replacement Tower roof will be planted with a contractor-developed [it was later discovered that Conservation Design Forum designed the green roof]extensive green roof system. Water collected from this system as well as from non-green roof surfaces, is diverted to one of three outfalls on the north wall of the new building and, in turn, dispersed into a channel/trench drain system that distributes the water to Rain Gardens 3 - 8. Each trench drain serves an opposite pair of rain gardens to the east. The first trench drain directs water to rain gardens 3 and 6, the second to rain gardens 4 and 7 and the third to rain gardens 5 and 8. As with other rain gardens, each of these is underlain with CA 7. "

Planting within the gardens includes the followings native species and species adaptable to drier conditions once established:
Little bluestem (Schizachyrium scoparium), (native grass)
Prairie dropseed (Sporobolous heterolepsis),(native grass)
Prairie Onion (Allium stellatum), (native forb)
White Wood Aster (Aster divaricatus), (native forb)
Aster oblongifolius 'October Skies', (native perennial cultivar)
Solidago 'Crown of Rays', (native perennial cultivar)
Perovskia atriplicifolia, (adapted perennial)
Nepeta x faassenii 'Walker's Low', (adapted perennial)
Geranium macrorrhizum 'Bevan's Variety', (adapted perennial)

<u>The Spiral Garden also includes additional native plants such as:</u>
Diervilla sessilifolia 'Butterflies', (native shrub cultivar)
Amsonia hubrechtii, (native perennial)
Dodecathon meadii, (native perennial)
Liatris spicata 'Kobold', (native perennial cultivar)
Panicum virgatum 'Heavy Metal', (native grass cultivar)
Linum perenne 'Saphir', (adapted forb)
Coreopsis verticillata 'Zagreb', (adapted forb)

Source:
Conservation Design Forum "Submittal documentation for LEED WE Credit 5.1-5.2" 2007. Authored by CDF staff Trish Beckford, RLA.

<u>Social</u>

Increased calmness in 57% of patients, reduced stress in 50% of patients, and made the hospital stay easier for 50% of patients utilizing the oncology infusion bay overlooking the green roof garden.

Provides pleasant views for 100% of patients surveyed. All preferred the views of the gardens to views of the nearby street, rooftop, and parking lot.

The primary objective of the patient study was to determine whether and how the landscape environment of the hospital contributes to the stress-reduction and healing benefits for patients. a healthcare setting, specific inquiry into the social and health benefits of the landscape are part of ongoing research interest in landscape architectural and environmental design. The results of the survey will contribute to a growing knowledge and understanding of the role of landscape architecture (the design of spaces, elements, and atmospheres) in the recovery of ill persons.

Through a questionnaire-based survey method, we gathered feedback on the hospital and clinic experiences of three identified groups: including oncology patients receiving infusion treatment. The surveys were organized in collaboration with Mary Larsen (Manager of Environmental Stewardship, Advocate Health Care), along with department managers and coordinators from participating units. The design of these spaces were intended to enhance the hospital environment as a place of healing; hence, the hospital is also interested in understanding the patient and staff experience of the landscape so that it may use this information to verify its intentions, to potentially improve upon or expand these spaces, and to promote its benefits to future patients. Thus, multiple conversations have taken place between researchers and the hospital coordinators to ensure that the questions within each of the surveys is appropriately targeting questions pertinent to the LAF case study and to the hospital to fit the specific conditions and perceived concerns of each community surveyed.

We developed a volunteer questionnaire-based survey for two identified patient communities within the hospital: pediatric patient's families and oncology patients receiving infusion treatment. The 1-2 page questionnaires asked questions about the experience of patients and families in utilizing and viewing the various outdoor spaces, seeking to understand whether they contribute to stress-reduction and other healing benefits. The surveys were in multiple choice, rating scale, and short-answer format, and were accompanied by a Consent Statement, providing information to the participant about the purpose and method of the survey. The surveys were made available to volunteer participants over a two-week period.

Illinois Institute of Technology - Institutional Review Board approval was applied for in order to conduct the research. The research team worked with IIT-IRB on the application, completed an online training to lead the study, and received approval on June 26, 2013. Advocate Lutheran approval was handled by Mary Larsen. Questions pertaining to this survey should be directed to Professor Mary Pat Mattson, mmattso2@iit.edu or IRB Director of Research Compliance, Glenn Krell krell@iit.edu.

Observation: During our visit to the infusion treatment center located in the Center for Advanced Care, we observed the infusion bays. One set of treatment bays looks out toward the gardens, another set looks out over a parking lot and busy street. There was an immediately noticeable difference between the two. The garden was also noted to be perceived as overgrown, hiding some of the more colorful, textural plants that make the garden so appealing. Wildlife in the form of ducks, nest and raise their young for the season within the garden, adding to the special interest and experience of the garden for oncology patients.

Surveys were given to hospital staff in the Advanced Care Oncology Department on 18 July 2013, and collected 31 July 2013. In this two-week period, 30 surveys were completed and returned to the CSI team. Notable findings, with discussion, include:

Garden Use

· 80% were familiar with healing garden spaces on the hospital grounds.
· 97% had been able to view rooftop garden, and 100% preferred the garden view (as opposed to infusion bays that overlook a gravel rooftop, parking lot, and busy Dempster Street). There was some

confusion about "using" the rooftop garden; responses indicated only 43% had “used” the rooftop garden, but 100% said they had at least passed by it. It seemed that responders equated “use” with being in the space, not just viewing it.

· The most common reasons for use of the outdoor garden space were: to be outside to relax (27%), to spend time outdoors (13%), and to sit with family members (10%). It should be noted that 0% chose the option to use gardens for “private time”, indicating that outdoor spaces have an important social role for patients.

Garden Design

The aspects of the garden that were most important to patients were: the feeling it elicited (calming) effects (50%), the view (40%), the flowers (23%), the wildlife (20%). These responses indicate important factors when designing healing gardens for this kind of hospital experience. While we hypothesized that seasonality would be an important factor, only 7% of the responses recorded this as an important factor. Within the short answer questions of the survey forms, it was noted by many that a colorful variety of flowering species, that bloom throughout the growing season so that color is always present in the garden, is an important factors in patients’ positive response to the garden. This rooftop garden has been a host for a family of ducks that hatched and grew up on the roof, and survey responses included several anecdotes about patients looking forward to seeing the ducklings during their hospital stays. While visiting the hospital, staff indicated that plants that would attract more butterflies would also be a great addition to the garden, to provide more visual wildlife.

Garden Effects

· 57% said the garden made them calmer, 50% said they felt less stress, 50% said they had an easier time in the hospital with the garden view.

· The question about how the garden made patients feel was multiple choice, with an option for “other”. In these anecdotes, 40% said the garden made them feel peaceful, 27% said the garden was relaxing, and 17% said the garden made them happy. These responses further support the positive effect the rooftop garden had on patients.

· It should be noted that 7% said the garden had no effect on their hospital experience. Although this small percentage of people did not experience positive effects from the garden, all responders did prefer the garden view, which indicates that this garden at minimum has a positive aesthetic effect.

Note: A second patient population, pediatric care, did not return a significant number of responses to the CSI team. Surveys were given to hospital staff in the Pediatric Department on 18 July 2013, and collected 31 July 2013. In this two-week period, 4 surveys were completed and returned to the CSI team. This lack of responses could be due to 1) distribution error; surveys may not have been distributed in an effective systematic way by hospital staff, or 2) this patient population was not optimal to target for this study. It could be that parents, who would be filling out the survey, were too concerned with the health and hospital experience of their child/children to complete the survey.

Increased positivity about the daily work experience for 62% of hospital staff, who only have viewing access to the healing gardens within the hospital.

We developed a questionnaire-based survey to be completed during a lunchtime forum with hospital staff, aiming to gauge the role of the landscape in improving a stressful work environment. The lunchtime event was held as a one-hour event, during which we presented a brief overview of the history of healing gardens and of recent research as presented through Clare Cooper Marcus’ “Gardens and Health” (2000) and Robert Ulrich’s “Effects of Gardens on Health Outcomes: Theory and Research” (1999).

The CSI research team hosted a lunch-and-learn on healing gardens for hospital staff and volunteers on 31 July 2013. Multiple-choice, rating scale, and short answer surveys were distributed at this event and filled out on a volunteer basis. Twenty-one completed surveys were collected during this event. Notable findings, with discussion, include:

Garden Use

- 86% of hospital staff were familiar with the healing garden spaces. We learned that hospital staff are discouraged from using garden spaces within the hospital, and are only encouraged to use the Spiral Garden, which is out front of the hospital; which possibly explains why not 100% of hospital staff were familiar with the hospital's garden spaces. However, 57% have used the Spiral Garden, 19% have used the Courtyard Garden, and 14% have used the Children's Garden (the last two were likely used by staff accompanying patients).
- With access limited to the Spiral Garden and viewing access to the interior gardens, 62% of hospital staff said the gardens positively affected their daily work experience.
- 81% had observed patients/families using garden spaces.
- Surveys recorded responses for the most important reasons to use garden spaces on a scale of 1 (not important) to 5 (most important). The reasons (from most important to least) were: to get away (an average of 4.61), to get a relief from work stress (4.55), to experience nature (4.55), to have a view (4.42), and to socialize (3.17). This may indicate that, whereas the oncology patient survey indicated a desire for outdoor social spaces, hospital staff desire more restful spaces.

Garden Design

- Only 38% reported positive feelings when in the garden space. Since these responses only took into account the experience of being in the Spiral Garden, this is probably due to the fact the Spiral Garden is located adjacent to busy Dempster Street, a major intersection, and a bus stop. Some anecdotes on the surveys described the Spiral Garden as "noisy" and "exposed" (the trees (*Gingko biloba*) in this garden are still quite small and provide very little shade).
- It's important to note that this experience, and perhaps the 'impression' of the busy streetscape context of the site, are seen as undesirable, which may deter staff from spending time in the Spiral Garden space.

Garden Effects

- When asked if garden spaces would fulfill certain needs, 62% said garden spaces would meet their mental needs, 57% for emotional needs, and 52% for spiritual needs, and 29% for physical needs. It should be noted that several surveys included anecdotes that these needs would only be met if staff were given access to all existing garden spaces on the hospital campus, not just the Spiral Garden.
- 57% of hospital said they would like more access to the garden spaces, or a separate staff garden (since existing gardens are focused on being places of patients and visitors).

Sources:

Marcus, Clare Cooper. "Gardens and health." *Design and health: the therapeutic benefits of design* (2000): 461-71.

Ulrich, Robert S. "Effects of Gardens on Health Outcomes: Theory and Research", in *Healing gardens: Therapeutic benefits and design recommendations*,Marcus, Clare Cooper, and Marni Barnes, eds. Wiley: 1999.

Cost Comparison Methodology

The construction cost for the landscape was approximately $2.4 million, with the enhanced stormwater-design features valued at approximately $132,500-219,500, representing an estimated 5.5-9.1% increase in construction cost over a more traditional landscape.

COSTRUCTION COST CALCULATION – Stormwater Features
The additional cost for stormwater features is based off the Power Construction Company's records of contractor scopes of work and associated cost.

Line items pertaining to porous pavement, CA-7 stone for the underground reservoir, bio-infiltration soils, plantings, and site overexcavation account for the 'surcharge' on the landscape cost associated with stormwater design. We estimated this surcharge at 15 - 25% of each item. According to Tom Price at CDF, "because of the large elevation difference between the street and the finish floor that we had to match, the retaining walls were needed along the street no matter the design. Thus, it created an opportunity to backfill with open graded stone to create storage rather than just standard backfill. Also, there was a desire to have high end landscape." The first factor allowed for the stormwater design to logically fit the site, therefore the additional cost is captured in an evaluation of the additional stormwater materials but does not contain the wall construction cost itself. A traditional site may have used these materials (both stormwater and finish landscape), but not to the extent, density or depth as utilized for the purposes of enhanced stormwater design and an improved aesthetic for the site.

Landscape Item	**Cost**	**"Surcharge", 15-25% (note: rounded up to nearest $500)**
Porous Paving	$125,180	$19,000-31,500
Site Excavation	$90,000	$13,500-22,500
CA-7	$205,000	$31,000-51,500
Plantings	$392,000	$59,000-98,000
Special Soils	$64,000	$10,000-16,000
TOTAL		$132,500-219,500

Although the hospital does not currently re-use the water that it collects and stores, because of the heavily regulated health industry and standards for water quality, their interest in integrating this strategy into future projects suggest a future savings of $16,046.64/annually for the same amount of water captured on a similar site. While not a significant cost for a hospital entity, this would be a great savings for a similarly sized site with a program that would allow for storage and re-use.

Estimates for Park Ridge water rates are that they are increasing by 18% annually and that sewer rates will rise to 100%, rates projected to be:
potable water rate = $3.05/1000gallons
sewer rate = 100% water rate

If the project stores 2,630,598 US gallons for potential re-use, the annual savings would be:
$8,023.32 potable water savings cost
+
$8,032.32 sewer costs
= $16,046.64 TOTAL WATER SAVINGS ANNUALLY

The hospital has experienced a reduction in expensive and time-consuming maintenance, including a reduction in chemical fertilizer application, mowing, weeding and other maintenance protocols of the typical hospital grounds landscapes. A special contractor is outsourced to conduct seasonal care for the plantings. Initial cost-savings are estimated to be $2600 annually.

In an interview with an Acorn landscape contractor on 28 June 2013 and 10 July 2013, Acorn Landscapes charge $38 per manhour. A crew of three people spend one day per week maintaining the project landscape, which consists of deadheading, weeding, cutting back, and picking up debris (which blows in from the busy Dempster Avenue intersection). According to the landscape contractor, compared to other sites on the hospital campus, this landscape is “very low maintenance” and the majority of maintenance consists of debris removal. This site requires no irrigation, mowing, or herbicide application.

On the hospital campus, sites that consist mostly of turf requiring mowing once per week, require six applications of herbicides annually, and aeration of turf once per season. However, due to the large amount of debris that blows onto the project site, about the same amount of time and people are required to maintain it compared with other sites on the hospital campus.

The maintenance of the project saves money by not requiring the application of herbicides and no aeration. Stated within Appendix 8: Examples of Natural Landscaping Installation and Maintenance Costs within “Source Book on Natural Landscaping for Public Officials” (1997), herbicide application costs an estimated $2000 for six applications over .87 acres. Aeration, which may not be necessary every year, costs an estimated $600.

Source:
"Sourcebook on Natural Landscaping for Public Officials", prepared by Northeastern Illinois Planning Commission, 1997. Reference to Appendix 8 is from the 2004 version, full document available at http://www.chicagowilderness.org/files/4413/3087/4878/natural_landscaping_sourcebook.pdf