PERFORMANCE AND ECONOMIC BENEFITS OF FOUR STREETSCAPE RENOVATIONS: A COMPARATIVE CASE STUDY INVESTIGATION

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1 ABSTRACT

The demonstration of landscape performance benefits has become increasingly important in landscape architecture practice and in communicating to interdisciplinary audiences. This paper provides an overview of the Landscape Architecture Foundation Case Study Investigation (CSI) program and introduces four built streetscape projects investigated in the 2012 CSI program, including a large-scale permeable pavement project in Charles City, Iowa, and the American Society of Landscape Architects' award-winning projects in Missouri, California, and Colorado. Unlike traditional streetscape design that mainly focuses on safety and engineering principles, these four streetscape projects tackled unique design challenges, and more importantly, have captured baseline data that help demonstrate landscape performance benefits and the effectiveness of design. Totally 32 performance benefits are captured through the CSI program (e.g., visual quality enhancement, and water and energy conservation). This paper specifically illustrates the 14 economic benefits. For each project, detailed methodology is provided for a selected economic benefit example demonstrating how the performance benefit was monetized. Findings suggest compelling economic benefits such as South Grand's streetscape project (Missouri), which is expected to provide $3 million annual savings to the City through significant reduction of traffic speed and accident rates and also the enhancement of pedestrian and ADA accessibility. The paper ends with a discussion on how streetscape projects can be improved through CSI research and key lessons learned from the CSI program (e.g., limited time-frame of conducting research and lack of financial support for first-hand data collection).

1.1 Keywords

sustainability, post-occupancy evaluation, Design Workshop, Conservation Design Forum, ecosystem services

2 INTRODUCTION

In 1999, Mark Francis wrote a report based on a research project he was commissioned to do for the Landscape Architecture Foundation (LAF). This report analyzed the pertinence of case studies for the advancement of the landscape architecture profession and developed a Case Study Method. Two of the final steps in the production of case studies recommended by Francis are that the completed case study be analyzed and the findings be disseminated and easily accessible for practitioners, academicians, and the public alike (Francis, 1999). Francis stressed the importance of having another party (academics, journalists, and users) involved in producing the case study to ensure objectivity. He also indicated the importance of taking a systematic approach to gathering information so that cases can be compared and replicated (Francis, 2001).

This paper is an attempt to help fulfill the above recommendations. As part of the 2012 LAF Case Study Investigation (CSI) program, four streetscape projects were evaluated with an emphasis on quantifying the economic, social, and environmental benefits. Project analyses were conducted collaboratively by a Utah State University research team, the design teams (i.e., Design Workshop and Conservation Design Forum), city officials, and other parties based on the original performance objectives set out by the design teams. This paper discusses key economic performance benefits for each project, data sources, and examples of methodologies that were used to quantify the economic benefits. The paper also provides recommendations on streetscape design and insights into the improvements of future LAF CSI programs.

3 LANDSCAPE PERFORMANCE RESEARCH INITIATIVE

The LAF defines landscape performance as the measure of efficiency with which landscape solutions fulfill their intended purpose and contribute toward achieving sustainability (Landscape Architecture Foundation). In 2011, the LAF established a seminal research initiative—Landscape Performance Series (LPS)—to assess the value of high-performing landscape projects through quantifying environmental, social, and economic benefits. LPS is designed to fill a critical gap in the marketplace and make the concept of “Landscape Performance” as well known as “Building Performance” (Landscape Architecture Foundation).The LPS is not a rating system, but rather a hub that compiles information and innovations from research, professional practice, and student work about landscape performance. LPS presents the latest information on performance benefits and best design practices and is organized by four categories: Case Study Briefs, Benefits Toolkit, Fast Fact Library, and Scholarly Works. They provide methodologies and references for researchable evaluation and measurements of landscape performance.

Case Study Investigation (CSI) is a LAF-funded research program that brings together academia and the industry to investigate and document the benefits of exemplary, high-performing built projects. Each year, eight to ten research teams composed of landscape architecture faculty members (serving as Research Fellows), research assistant(s) (e.g., students), and firm practitioners are selected across the United States. This CSI research program lasts 3-4 months. It focuses on evaluating performance benefits of built landscape architecture projects and the products from the CSI studies comprise the database of LAF Case Study Briefs.

CSI was launched in the summer of 2011, conducted again in 2012 and 2013, and is expected for the years to follow. The 2011 CSI program exemplifies the performance benefits of best design practices, balancing project types, scales, and geographic locations. The 2012 CSI program further poised the LAF on the research front by becoming more rigorous in case study selection, encompassing a broader spectrum of sustainability metrics (e.g., projects must document social, environmental, and economical benefits), and emphasizing the importance of social benefits, which has yet to become a strength of landscape architects.

4 STREETSCAPE DESIGN AND PERFORMANCE BENEFITS

Streetscape design is a vital component of street public spaces and impacts the way people interact in the street public realm. A well-designed streetscape improves the aesthetic quality and safety of the street, boosts economic growth, and promotes social activity and comfort of communities (Jacobs, 1995, p.4). Streetscape design involves meeting legal and functional requirements. Although the design process goes beyond a simple exercise that aims at moving vehicles conveniently, traditional streetscape

design largely focuses on vehicle mobility, leading to unsafe and unfriendly pedestrian and bicycle environments.

Developing a sustainable framework for streetscape design is gaining traction for both transportation and landscape architecture professionals. For instance, Greenberg (2009) proposed the three "E" (environment, equity, and economy) sustainable street design framework—"multimodal rights-of-way designed and operated to create benefits relating to movement, ecology, and community that together support a broad sustainability agenda" (Greenberg, 2008, p.29-39). The four streetscape projects evaluated in the CSI program address the above values and illustrate how social, economic, and environmental interactions form a sustainable streetscape design.

4.1 Case Study Sites

These streetscape projects are: Charles City Permeable Streetscape in Charles City, Iowa (Conservation Design Forum and Charles City, 2009; Yang, Zhang and Blackmore, 2012a); Cherry Creek North Improvements in Denver, Colorado (Design Workshop, Inc., 2011; Yang, Zhang, and Blackmore, 2012b); South Grand Boulevard Great Streets Initiative in St. Louis, Missouri (ASLA, 2011; Yang, Zhang, and Blackmore, 2012c); and the Park Avenue Redevelopment in South Lake Tahoe, California (Design Workshop, Inc., 2010; Yang, Zhang, and Blackmore, 2012d). The first one, designed by Conservation Design Forum, is one of the largest permeable pavement projects in the United States. The remaining three are designed by Design Workshop, all of which are American Society of Landscape Architects' award-winning projects. Project locations, size, and year of completion are shown in Figure 1.

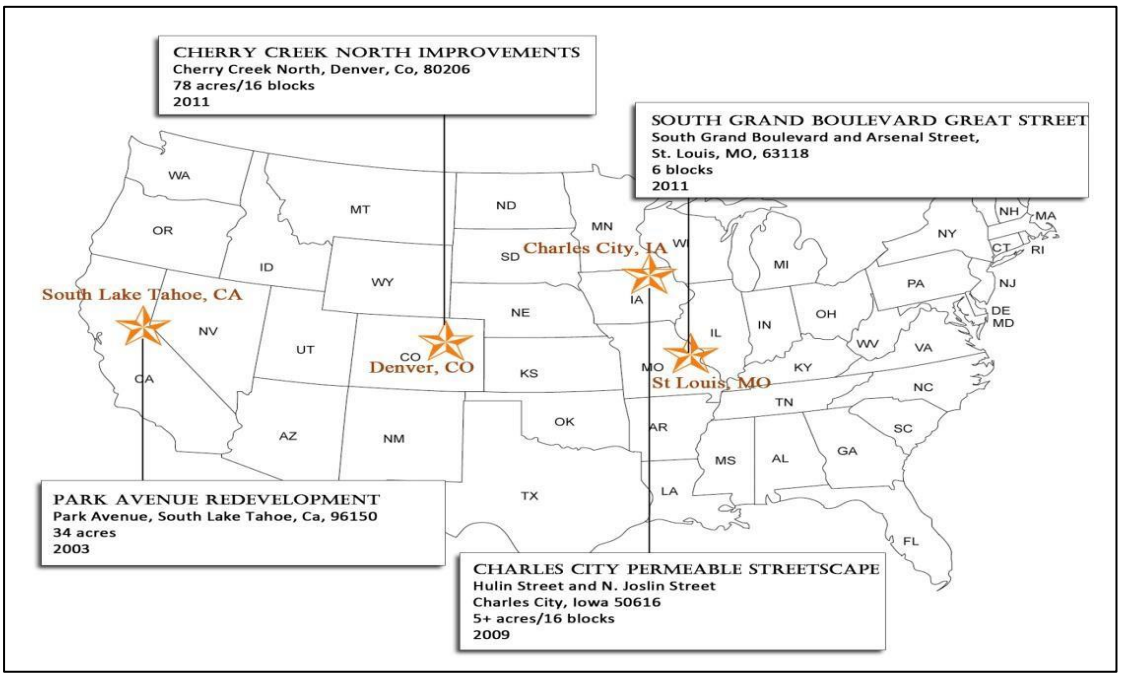

Figure 1. Streetscape project location, project size, and year of completion

The four projects tackled unique design challenges and captured baseline information. These projects were assessed by Performance Benefits and Sustainable Features. Some ky Sustainable Features include stormwater management, pedestrian right-of-way improvement, safety and transportation enhancement, and use of green infrastructure and recycled materials. Several compelling Performance Benefits include safety and accessibility, visual resource and aesthetics enhancement, and water and energy conservation. The corresponding metrics are shown in Figure 2.

● Performance Benefit / ● Sustainable Feature	LAND			WATER				HABITAT		CARBON, ENERGY & AIR QUALITY				MATERIALS AND WASTE			ECONOMIC				SOCIAL					
	Transportation	Land Efficiency/ Preservation	Soil creation/ Restoration	Stormwater Management	Water Conservation	Water quality	Flood protection	Habitat Preservation	Habitat creation/ Restoration	Temperature & Urban Heat Island	Air Quality	Energy Use & Emissions	Carbon Storage & Sequestration	Reused/Recycled Materials	Local Materials	Waste Reduction	Property Values	O&M Savings	Economic Development	Job Creation	Recreational & Social Value	Public Health & Safety	Educational Value	Noise Mitigation	Food Production	Scenic Quality/Views
Charles City, Iowa				●		●	●							●				◐	◐		◐					
Park Avenue, South Lake Tahoe, California	●	◐		●	◐	◐		◐			●	◐		◐				●	◐		◐	◐				●
South Grand, St.Louis Missouri	●		◐	●	◐				◐			●	●	◐		◐		●	●		◐	●		●		●
Cherry Creek North, Denver, Colorado	◐			◐	●	●				●		●		●		◐		●	●		◐	◐				

Figure 2. Performance Benefits and Sustainable Features of streetscape projects

For example, the social benefits of South Grand Boulevard showcase intriguing features. Landscape architecture firm Design Workshop worked with the Missouri School for the Deaf and the Missouri School for the Blind, the major schools in the project site, to improve ADA accessibility at all intersections to 100%. Revised streetscape design and visual and audio cues help orient the visual and hearing impaired students and allow them to familiarize themselves with urban environments. In addition, as a result of the revised design, the traffic speed was reduced from 42 mph to 25 mph, and the probability of pedestrian fatality on vehicular impact was reduced from 100% to 25% (McLean, Anderson, Farmer, Lee, and Brooks, 1997). Related benefits include an 85% decrease in traffic accidents and an expected $3 million savings in medical care for the city of St. Louis over the next 25 years (Yang et al., 2012c).

In addition, to effectively communicate Sustainable Features and project aesthetics to the designers, clients, and decision makers, LAF requires a pair of images to show the *before* vs. *after* or the *traditional* vs. *sustainable* conditions. Figure 3 is an example in the Park Avenue and U.S. 50 Redevelopment streetscape project. Before project redevelopment, unplanned development along Park Avenue degraded the environmental and scenic assets of the area. The revitalization replaced visual clutter with consistent building massing, signage, awnings and overhangs, street trees, planted areas, and street furniture, creating a comfortable, safe, and enjoyable pedestrian environment (Val, 2007; Yang et al., 2012d).

Figure 3. Park Avenue and U.S. 50 Redevelopment streetscape project before (left image) and after (right image) conditions (Source: D. A. Horchner/Design Workshop. Used by permission)

4.2 Economic Benefits Assessment

A key component of CSI research is to assess the Performance Benefits through valid datasets and methodologies. Estimating the economic value of certain landscape projects is perhaps the most challenging aspect in CSI research. The Utah State University research team assessed totally 32 Performance Benefits for these four streetscape projects (producing 26 pages of methodology documents). Although it is beyond the scope of this paper to introduce a complete list of these methodologies (available online, see Yang et al., 2012a, 2012b, 2012c, 2012d), this paper highlights the economic benefits as a result of streetscape design interventions and innovations.

One way of assessing the economic benefits is through the process of monetization, which transforms the direct and indirect benefits into a dollar value (Macdonald, Sanders, and Anderson, 2009). While not every performance benefit can be or should be represented in monetary value, a comparison between different alternatives is an effective and persuasive way to demonstrate project performance and contribution to environmental stewardship, economy, and society (U.S. EPA, 2012). The economic benefits and detailed data sources are presented below.

Case Study 1: Charles City Permeable Streetscape, Iowa

This project is the first permeable paving project in Charles City, which consists of 16 blocks in a historic residential district. The district suffered from crumbling streets and stormwater flooding. Instead of using conventional concrete or asphalt paving, the project combined durable permeable pavement with cobble infiltration and bioretention to tackle stormwater problems. It also eliminated the replacement of the existing storm sewer system. The project reduced stormwater peak flows by 75% and runoff volume by 60% for 10-year storm events. Economic Benefits of the project include:

- Saved $57,000 by preserving 192 street trees (*Data source:* Conservation Design Forum)
- Secured $731,000 in additional funding that would not have been available (*Data source*: ASLA Green Infrastructure and Stormwater Management Case Study, Case 191)
- Saved approximately $395,000 in construction and permitting costs by using permeable interlocking concrete unit pavers when compared to cast-in-place porous concrete (*Data source:* Conservation Design Forum and Charles City. 2009. Charles City Green Streets Evaluation and Design Report)

Case Study 2: Cherry Creek North Improvements and Fillmore Plaza, Colorado

This project revitalized Denver's premier retail district and created a pleasant social and commercial multi-purpose place. The new streetscape strengthens the retail environment, preserves the district's history and character, improves identity, beautifies the area and improves the shopping experience in this district. Economic Benefits of the project include:

- Increased the District sales tax revenues by 16% (over $1 million) in the first year after construction (*Data source:* Sales Tax Revenues: Cherry Creek North BID year-end financial statement)
- Decreased retail vacancy rates from 13.6% in 2009 to 7.2% in 2012 (*Data source:* Newmark Knight Frank, Cherry Creek North Aggregate Historical Vacancy Report.)
- Reduces annual water consumption for irrigation by 3,376,000 gallons, saving $17,600 annually (*Data source:* Hydro Systems, Inc.)
- Estimated to save an additional $10,000 per year in reduced maintenance costs (*Data source*: Irrigation system designer)
- Reduces annual energy consumption for outdoor lighting by 223,000 kilowatts, saving $12,700 in energy and $1,000 in maintenance and material costs each year (*Data source*: Cherry Creek North BID and Scanlon Szynskie Group lighting consultant's power consumption spreadsheet)
- Saved $188,000 by reusing 331 light pole footings and bases in place, on-site (*Data source*: Design Workshop, Inc.)

Case Study 3: South Grand Boulevard Great Street Initiative, Missouri

South Grand aimed to mitigate the negative impacts (noise, accidents, mobility, and excessive

traffic speed) of the existing streetscape design. The street is refigured to still allow for vehicular mobility, but at speeds that are safer and less likely to cause accidents. By installing tactile crosswalk striping, visual and audio cues, and detectable warnings and signalization, the project improves ADA accessibility, creating an environment that is usable for people of all abilities. Economic Benefits of the project include:

- Increased annual tax revenue more than 14% in the first year after redevelopment (*Data source:* South Grand East-West Gateway)
- Expected to reduce traffic accidents by 85% due to dropping traffic speed from 42 mph to 25 mph (projected), resulting in an expected $3 million annual savings to the City (*Data source:* Taylor, Lynam, and Baruay, 2000)
- Projected to increase revenue by 19% over a 10 year period (*Data source*: Design Workshop, Inc.)

Case Study 4: Park Avenue & US 50 Redevelopment Phase 1, California

The project is a major tourist gateway in Lake Tahoe, California. The biggest design challenge was the "scenic quality", which was recognized as the most important asset of the region. By redefining the setbacks and creating several view corridors, landscape architects met stringent environmental guidelines on visual quality preservation while achieving project economic goals. The improvement of the streetscape created a sense of arrival and helped increase aesthetic value of the community. Economic Benefits of the project include:

- Achieves a total annual tree benefit of $11,424 by preserving 112 Jeffrey pine (*Data source*: Online National Tree Benefit Calculator)
- Reduced fertilizer consumption by approximately 70%, saving an estimated $880 annually (*Data source*: California Agriculture and Natural Resources information)

4.3 Sample Methodologies

An example methodology is given for each project in respect to the procedure of monetizing the performance benefits. The complete methodology documents are available at: Charles City Permeable Streetscape (http://www.lafoundation.org/myos/my-uploads/2012/10/16/charles-city-permeable-streetscape-methodology.pdf), Cherry Creek North Improvements and Fillmore Plaza (http://www.lafoundation.org/myos/my-uploads/2012/09/17/cherry-creek-methodology.pdf), South Grand Boulevard Great Street Initiative (http://www.lafoundation.org/?page_id=501&template_id=31&preview=true), and Park Avenue & US 50 Redevelopment Phase 1 (http://www.lafoundation.org/myos/my-uploads/2012/10/31/park-ave-methodology.pdf).

Case Study 1: Charles City Permeable Streetscape, Iowa

Economic Benefit: The project uses permeable interlocking concrete unit pavers as a high-performance, cost-effective pavement, which saves approximately $395,000 in construction and permitting costs when compared to cast-in-place porous concrete for the 5,670 linear feet (LF) of streets that were replaced.

Methodology: Based on the Charles City Green Streets Evaluation and Design Report, the estimated unit cost of a permeable paver road is $530/LF to construct the road cross section proposed for the City. The estimated unit cost of porous concrete road is $590/LF. The above price includes removal of the existing pavement and installation of the stone base, required drainage, curbs, and the permeable pavers. The project covers 6 streets and the overall length in this project is 5,669 LF. The Contingency and Design and Permitting Fees rates are 10% and 6%, respectively. Therefore the overall costs savings are:

($590/LF – $530/LF) × 5,669 LF + ($590/LF – $530/LF) × 5,669 LF × 16% = $ 395,000
Where: LF = Linear Feet

Case Study 2: Cherry Creek North Improvements and Fillmore Plaza, Colorado

Economic Benefit: Instead of using traditional turf-grass, more than 50% of the planted areas were replaced with low-water-use landscaping, reducing annual water consumption by 3,376,000 gallons. This saves approximately $27,600 annually from the irrigation water budget (Yang et al., 2012b).

Methodology: All of the following calculations are based upon project baseline data of 2008. Data of 2011 were used as the year for comparison. The project replaced over half of the spray-irrigated turf areas with drip-irrigated, water-wise perennials and shrubs. This resulted in a reduction of annual landscape water consumption from 9,582,000 gallons in 2008 to 6,206,000 gallons in 2011. In addition, Denver utility statistics showed that 2008 winter irrigation consumption (October 28 through May 2) was 0 gallons, and summer (May 3 through Oct 27) was 9,582,000 gallons. In 2011, after the above landscape improvements, winter water consumption totaled 378,000 gallons, and summer 5,828,000 gallons. The total amount of water saved can be calculated as follows:

Irrigation water rate in Denver is $1.20 per 1,000 gallons in winter (October 28 through May 2), and $4.81 per 1,000 gallons in summer (May 3 through Oct 27). Water savings were calculated by subtracting water costs in 2011 by 2008:

$4.81/1,000 gals × 9,582,000 gals – (($1.20/1,000 gals ×378,000 gals) + ($ 4.81/1,000 gal × 5,828,000 gals)) = $17,602.72

Moreover, the low-water-use landscaping requires less maintenance than turf. Calculated by the irrigation system designer, the annual operating budget was reduced by approximately $10,000. Therefore, the total saving annually would be: $17,603.17 + $10,000 = $27,603.17

Case Study 3: South Grand Boulevard Great Streets Initiative, Missouri

Economic Benefit: Reduced traffic accidents by an expected 85% through dropping traffic speed from 42 mph to 25 mph, resulting in an expected $3 million annual savings to the city. The probability of pedestrian fatality upon vehicular impact dropped from 100% to 25% (ASLA, 2011; Yang et al., 2012c).

Methodology: Speed is an aggravating factor in the severity of all crashes. The relationship between speed and the outcome of a crash is directly related to the kinetic energy that is released during a collision. The more kinetic energy to be absorbed in a collision, the greater the potential for injury to vehicle occupants and pedestrians hit by the vehicle (Walz, Hoefliger, and Fehlmann, 1983). On average, each 1 mph reduction in speed may reduce accident frequency by 5% (Taylor, Lynam, and Baruay, 2000). In South Grand Boulevard, traffic speeds reduced from an average of 42 mph (68 km/h) to 25 mph (40 km/h). Therefore, the reduction in accidents can be estimated as (42 mph – 25 mph) × 5%/1mph = 85%.

According to the U.S. Department of Transportation and the National Highway Traffic Safety Administration (2000) adjusted to 2010 dollars, the median cost of a crash is around $44,000. This includes costs typically absorbed by local governments (police department, emergency services, property damage). In addition, the median value of the *total cost* is about $319,000. This estimate includes quantifiable economic impacts as well as emotional impacts that affect the lives of crash victims and their families. There was, on average, 90 accidents per annum along this section of South Grand Boulevard from 2004 to 2009. Therefore, the average accident cost ranges from $3,960,000 to $28,710,000 per year.

Based on the above analysis, accidents are expected to be reduced by 85% compared to the existing conditions. Taking the value of 90 annual crashes and multiplying it by 85%, indicates a forecasted 76 fewer crashes. This will yield a range of savings between $3 million and $24 million per year.

$44,000 × (90 × 85%) = $3,300,000
$319,000 × (90 × 85%) = $24,400,000

Case Study 4: Park Avenue & US 50 Redevelopment Phase 1, California

Economic Benefit: Reduced fertilizer consumption by approximately 70% through using slow-growing turfgrass and organic fertilizer, saving an estimated $880 annually.

Methodology: The University of California Agriculture and Natural Resources recommend the fertilizer application rate for the traditional turfgrass as 1 lb per 1,000 square feet, 4 times a year (i.e., 4 lbs/1,000 square feet/year) (http://www.ipm.ucdavis.edu/TOOLS/TURF/MAINTAIN/fertamt.html). In comparison, this project uses approximately 1.3 lbs of Biosol or other organic fertilizer per 1,000 square

feet/year.

The site has 5.9 acres (257,004 square feet) of dwarf turf grass (Aurora Hard Fescue, Mokelumne Fescue, or other types). Biosol costs around $83 for a 55 lb bag from a California distributor (http://www.ssseeds.com/ssseeds/display.php?key1=fertilizer&olimit=0&zid=1&lid=1&cartid=201210166152409). A 40 lb bag of traditional fertilizer from Lowe's costs $54 (http://www.lowes.com/pd_90204-446-31115_0__?productId=3047138). Fertilizer cost savings is calculated below.

Annual traditional turfgrass fertilizer cost:
4 lbs/1,000 sq. ft/yr × (257,004 sq.ft./1,000sq.ft.) = 1,028 lbs/yr
$54/40 = $1.35/lb; $1.35/lb × 1,028 lbs/yr = $1,387/yr

Annual Dwarf turfgrass with Biosol fertilizer cost:
1.3 lb/1,000 sq. ft/year × (257,004 sq.ft./1,000 sq.ft.) = 334 lbs
$83/55 lb = $1.51/lb; $1.51/lb × 334 lbs = $504/yr

Annual Fertilizer consumption reduction:
(4 lbs –1.3 lbs)/4 lbs = 68%

Annual fertilizer cost savings:
$1,387– $504 = $883

5 DISCUSSION

5.1 Revelations on Streetscape Design and Performance Assessment

Despite the promising evidence of streetscape performance, several issues emerged which warrant future investigations that can better promote sustainable streetscape designs. First, communication becomes paramount when implementing innovative streetscape designs vs. conventional designs in order to adapt the mindset of clients and users. Because of public involvement on South Grand, the redeveloped streetscape overcame initial objections and achieved consensus and strategic trade-offs. Likewise at Park Avenue, coordination with the Tahoe Regional Planning Agency allowed zoning changes that enabled more diverse pedestrian environments. Conversely, maintenance issues seem to be a problem when users do not understand maintenance expectations associated with unconventional designs. For example, the cobble infiltration areas in the Charles City permeable streets created excessive maintenance because of debris clogging the system and were removed in further stages. Hence, maintenance regimes should be decided in advance with budget constraints and maintenance responsibilities clearly identified. This is especially important when innovative designs have been implemented and city codes and ordinances are not applicable, and people's mindsets have not yet adjusted to new maintenance procedures. By documenting this performance and evidence, LAF case studies will provide a powerful tool for designers to convince future developers and city officials.

Second, baseline data collection is essential to demonstrate performance. It was found that the level of success in communicating landscape performance is closely correlated with how well the design-research paradigm was established. For example, Design Workshop's Legacy Design uses a rigorous metric system to document baseline data and evidence, allowing the research to take place relatively smoothly. Where baseline data were not captured, other tools are used, which oftentimes lead to assessments that are rather general, resulting in suspicion of reliability. Because no two projects are identical, competing objectives for each project create differing processes and outcomes, making it difficult to compare case studies (Culbertson and Martinich, 2012). If baseline data are captured using standardized methods, this aspect can be vastly improved.

Third, the Return on Investment (ROI) has not been fully addressed in the economic equations in these case studies. It is often believed that sustainable design would present more upfront cost. Increased emphasis on the ROI, though a limitation of the current study, would improve understanding of potential economic impacts of sustainable streetscape redevelopment. In Park Ave, for example, this ROI issue became obvious. A newly built parking structure, located out of visibility for improved aesthetics, is not generating its anticipated revenue because tourists who are unfamiliar with the area do not know where it is located. The visitors instead park in nearby free lots, occupying local business' stalls. Foresight from

these case studies may help improve economic viability of similar future projects if more emphasis is placed on the ROI.

5.2 Lessons Learned from the CSI Program

The LPS research initiative and the CSI program in specific, have solidified LAF's leadership in advancing landscape architecture research. The landscape architecture profession cannot rely on other disciplines to generate empirical knowledge (Milburn, Brown, Mulley, and Hilts, 2003). In this sense, LPS and CSI are making headway in promoting original research and evidence-based design. In addition to the successful stories presented above, the research team has the following observations and recommendations. First, the evaluation of streetscape project performance, similar to other sustainable project assessments, is an intertwined, multi-disciplinary effort (Brown and Corry, 2011; Culbertson and Martinich, 2012). The constraints of time and resources have limited the extensiveness of the case studies. With limited travel funding and project sites scattered across the United States, the research team did not have the opportunity to travel to the sites. This restricted the team's understanding of each site, giving limited interaction with clients and users.

Second, the case study production is primarily conducted in the summer months. This limited time frame may also reduce the quality of the study. For instance, there was minimal time to capture additional data, so some benefits could not be assessed, even though the team understood that they could have been analyzed with more time. This may not be a good image to other disciplines suggesting that "cheap, quick" research is being performed in landscape architecture. What is encouraging, though, is that the LAF has reported increased visibility with 2012 activity on the LPS website, doubling 2011's activity. LAF also indicated that the most visited portion of the LPS website in the past year is the Case Study Briefs (http://www.lafoundation.org/news-events/blog/).

Third, it is important to mention the necessity to conduct long-term assessment and/or monitoring of project performance, in addition to the "one-time shot" analysis. A research team consisting of the same authors of this paper is currently conducting a 5-year stormwater quality monitoring study in the Daybreak community of South Jordan, Utah. To its credit, Daybreak is published in the 2011 CSI program and it is one of the most discussed CSI case studies (Yang and Goodwin, 2011; Yang and Blackmore, 2013).

6 CONCLUSION

The above analyses show that innovative streetscape design can yield multiple performance benefits and the economic benefits are quantifiable. Through the CSI research, not only is the landscape profession as a whole benefiting from CSI, but participating firms and students are also reaping rewards. Firms taking part in CSI benefit from unbiased post occupancy evaluation of their work, which promotes their sustainable practices. Students are learning new methods to gauge the quality of their own work including methods and tools that may not be covered in their curricula. As a result of the CSI experience, they may never approach design the same way again. Finally, to make a lasting impact, it is important for future CSI teams to disseminate research findings in peer-reviewed venues and approach a large audience.

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8 REFERENCES

American Society of Landscape Architects (ASLA). (2011). ASLA 2010 Professional Awards: South Grand Boulevard "Great Streets Initiative." Retrieved from: http://www.asla.org/2011awards/192.html.

Brown, R. D., & Corry, R. C. (2011). Evidence-based landscape architecture: The maturing of a profession. *Landscape and Urban Planning*, 100 (4), 327–329.

Conservation Design Forum and Charles City. (2009). Charles City, Iowa permeable pavement project report. Retrieved from: http://www.scribd.com/doc/51712226/Charles-City-iowa-permeable-pavement-project-report.

Culbertson, K., & Martinich, M. (2012). *A holistic approach to sustainability: Lessons from the Lafitte*

greenway in New Orleans, Louisiana. *Edinburgh Architectural Research Journal*, 33, 1–14.
Design Workshop, Inc. (2010). American Society of Landscape Architects Colorado Chapter Honor Award: Park Avenue Redevelopment. Retrieved from: http://www.aslacolorado.org/2010-awards-archive.
Design Workshop, Inc. (2011). American Society of Landscape Architects Colorado Chapter. Fillmore Plaza, Merit Award. Retrieved from: http://www.aslacolorado.org/wp-content/themes/aslaco/images/awardentries_2011/Design1A_FillmorePlaza_FS9.pdf.
Francis, M. (1999). *A case study method for landscape architecture*. Washington, DC: Landscape Architecture Foundation.
Francis, M. (2001). A case study method for landscape architecture. *Landscape Journal*, 20 (1), 15–29.
Greenberg, E. (2008). Sustainable streets: An emerging practice. Institute of Transportation Engineers, *ITE Journal*, 29–39.
Jacobs, A. B. (1995). *Great Streets*. Cambridge, MA: The MIT Press.
MacDonald, E., Sanders, R., & Anderson, A. (2010). Performance measures for complete, green streets: A proposal for urban arterials in California (Monograph No. UCTC-FR-2010-12). University of California Transportation Center. Retrieved from: http://www.uctc.net/research/papers/UCTC-FR-2010-12.pdf.
Mclean, A. J., Anderson, R. W. G., Farmer, W. J. B., Lee, B. H., & Brooks, C. G. (1997). Vehicle travel speeds and the incidence of fatal pedestrian crashes. *Accident Analysis & Prevention*, 29 (5), 667–674.
Milburn, L.-A. S., Brown, R. D., Mulley, S. J., & Hilts, S. G. (2003). Assessing academic contributions in landscape architecture. *Landscape and Urban Planning*, 64, 119–129.
Taylor, M., Lynam, D., & Baruay, A. (2000). The effects of drivers speed on the frequency of road accidents (*TRL Report No. 421*). United Kingdom: Transport Research Laboratory.
U.S. Department of Transportation and National Highway Traffic Safety Administration. (2001). Traffic safety facts 2000: A compilation of motor vehicle crash data from the fatality analysis reporting system and the general estimates system. Retrieved from: http://www-nrd.nhtsa.dot.gov/Pubs/TSF2000.pdf.
U.S. Environmental Protection Agency (U.S. EPA). (2012). The Economic Benefits of Protecting Healthy Watersheds (*EPA No. 841-N-12-004*). Retrieved from: http://www.lcbp.org/PDFs/2012economic_benefits_factsheet2.pdf.
Val, M. (2007). *Towards Legacy*. Denver: Grayson Publishing.
Walz, F. H., Hoefliger, M., & Fehlmann, W. (1983). Speed limit reduction from 60 to 50 km/h and pedestrian injuries. In *27th Stapp Car Crash Conference with International Research Committee on the Biokinetics of Impact* (IRCOBI), 277-285.
Yang, B., & Blackmore, P. (2013). Low impact development in Utah: Is it effective? Utah Chapter of the American Society of Landscape Architects, May Newsletter. Retrieved from: http://aslautah.org/wp-content/uploads/2013/06/May-Newsletter-2013.pdf.
Yang, B., & Goodwin, A. (2011). Daybreak Community. Landscape Architecture Foundation: Case Study Briefs. Retrieved from: http://lafoundation.org/research/landscape-performance-series/case-studies/case-study/360.
Yang, B., Zhang, Y., & Blackmore, P. (2012a). Charles City Permeable Streetscape Phase I. Landscape Architecture Foundation, Case Study Briefs. Retrieved from: http://www.lafoundation.org/research/landscape-performance-series/case-studies/case-study/504
Yang, B., Zhang, Y., & Blackmore, P. (2012b). Cherry Creek North Improvements and Fillmore Plaza. Landscape Architecture Foundation: Case Study Briefs. Retrieved from: http://www.lafoundation.org/research/landscape-performance-series/case-studies/case-study/502
Yang, B., Zhang, Y., & Blackmore, P. (2012c). South Grand Boulevard Great Street Initiative (In review). Landscape Architecture Foundation: Case Study Briefs. Retrieved from: http://www.lafoundation.org/?page_id=501&template_id=31&preview=true
Yang, B., Zhang, Y., & Blackmore, P. (2012d). Park Avenue & US 50 Redevelopment Streetscape. Landscape Architecture Foundation, Case Study Briefs. Retrieved from: http://www.lafoundation.org/research/landscape-performance-series/case-studies/case-study/503