II

RESEARCH ARTICLES

ARTFUL RAINWATER DESIGN IN THE URBAN LANDSCAPE

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ABSTRACT

The idea of artful rainwater design is based on the premise that new stormwater management techniques focusing on non-point source pollution, water balance, and small-storm hydrology can be used to create projects resulting in greater user satisfaction and perceived value. Examination of exemplary artful rainwater designs can provide engaging and useful information to guide designers in their own artful rainwater designs. This article is grounded in case studies of selected artful rainwater designs and offers two concepts to the existing body of stormwater management design knowledge by drawing attention to the valuable project attributes common to artful rainwater design projects, and by clarifying specific project approaches that can enhance the value of stormwater management systems. The article includes specific project examples to illustrate these project attributes and design possibilities. The article concludes by discussing some of the opportunities and challenges faced by those advancing artful rainwater designs.

INTRODUCTION

> The treatment of stormwater runoff in conventional urban development has been driven by an attitude of "out of sight out of mind." This attitude reflected the view that stormwater runoff has no value as a useful resource and adds little to the amenity (aesthetic, recreation, education, etc.) of an urban environment. (Wong & Eadie, 2000)

This attitude, however, is beginning to hold less sway: we are starting to see a change as stormwater management design expands beyond the traditional approach of simply controlling flow rates and keeping costs down as communities recognize environmental impacts far beyond storm sewers and dry detention basins. Such innovative stormwater management should be a part of any "green building" program. Exactly why some communities are now recognizing that artful rainwater design can add value far beyond the required hydrological function may be difficult to pinpoint; however, communities have recognized that artful rainwater design can add value far beyond the required hydrological function and that rainwater systems can reflect the objectives and values of prospective users and not be viewed simply as a stormwater disposal systems. Although stormwater management facilities must meet hydrological objectives (such as flow rate, volume, frequency, duration, and quality), they can also have other tangible positive outcomes, particularly added community value, such as people-pleasing landscapes and designs that reveal something about rainwater and natural site processes. We need to be able to better assess the range and nature of these other outcomes and how we might approach stormwater design to achieve more added value. Therefore, this study investigates attributes of stormwater management design that enhance a project's non-hydrological values.

What is "added value" in stormwater management design? According to Frank Spink (Bookout et al., 1994), "A consensus has always existed among many design professionals and developers that good design makes a significant contribution to the value of a development project." The concept of adding value via stormwater design is based on creating designs that not only address stormwater in environmental and utilitarian ways, but that skillful collaboration of many design disciplines can create projects recognized by municipalities, clients, and users as enhancing both property values and quality of life. Simply stated, artful rainwater design creates multi-objective projects of which stormwater management is only one of the objectives. According to Wong and Eadie (2000),

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There is no place for the attitude "stormwater management should be left to engineers, or wetland design should be left to landscape architects." History has clearly shown that employing a single-disciplined approach to design more often than not leads to failure of the design.

New design opportunities for artful rainwater design are created in part by new U.S. Environmental Protection Agency regulations that require thousands of municipal governments to create, develop, adapt, and implement stormwater management programs to reduce non-point source pollution (USEPA, 2005). These regulations are often satisfied by bioretention, infiltration and many other distributed rainwater management systems integrated in the framework of earthwork, walkways, structures, and plantings that accompany new building. Designers around the world involved in land management and stewardship see such regulations as an important step forward, and many creative firms see potential for significant benefits beyond satisfying new regulations. Innovative rainwater design can be used to create places recognized as beautiful, meaningful, and educational—from lush rain gardens to plazas that artfully expose how rainwater flows across and infiltrates into land. This new focus on multi-objectivities can transform stormwater management facilities into artful rainwater designs that increase property values and function as community amenities, whether people learn about our hydrologic cycle and ecological systems or simply enjoy an attractive design. If this opportunity is so significant, why hasn't it been embraced as standard practice?

One reason is many stormwater treatment designs fail to add value that is easily recognized by the public.

A homeowner stares uncomfortably out the back window at the bioswale that collects stormwater from the home where she lives. "I know it's good for the environment," she says apologetically, "but I can't help wanting to mow it down—it just looks messy to me."

A major university scraps an innovative landscape plan that includes porous paving, bioswales, and native plantings for a new building. An official explains, "It's just too different from what we're accustomed to. The extra cost isn't offset by a clear benefit."

If artful rainwater design is to become better recognized as a community asset, the two critical gaps represented by these statements must be addressed. The first gap is between the public's concern with the appearance of stormwater facilities and most designers' lack of concern with appearance. The statement of the homeowner given above typifies public reaction to the visual character of much ecologically focused design: the designs often look messy, unsightly, and unkempt to the public eye. This issue has been addressed by numerous researchers including R. Kaplan (1983), Kaplan et al. (1998), Herzog (1989), Pennypacker (1993), and Nassauer (1995). Joan Nassauer has not only studied the problem but offered solutions (1995, 1997), as has Marcia Eaton (1997). They have shown that people value neatness in their landscapes as a symbol of stewardship and good citizenship. Still, too few designers have succeeded to date in incorporating rainwater design in ways that are appreciated by the public. Unfortunately, stormwater facilities are often engineered simply to solve excess runoff problems with no concern for aesthetic or other qualities. This, in turn, causes the second gap.

This second gap is represented by the second statement above: If rainwater management facilities are not seen as offering a clear "value-added" amenity—one that attracts business for developers and/or creates a desirable image and good public relations—land owners will not spend money to properly maintain existing systems, nor will they invest in additional stormwater management construction. Design for stormwater facilities then focuses on finding the lowest-cost solutions rather than creating value-added amenities. Thus, an extraordinary opportunity is lost. This article therefore reports on observations and analyses of innovative projects to answer this question: What attributes of stormwater management design enhance a project's attractiveness and/or value? The intent is to provide examples of proven and practical ideas to designers who wish to create their own artful rainwater designs in the urban landscape.

BACKGROUND

The fundamental ideology of protecting public health, safety, and welfare that focuses on desired hydrological outcomes is well documented in current stormwater management publications (Roesner & Matthews, 1990; Tourbier, 1994) along with specific

stormwater management techniques for promoting groundwater recharge, reducing pollutant loads, protecting stream channels, preventing increased overbank flooding, and safely conveying large floods (Schueler et al., 1992; USEPA, 2005). Specific techniques for creating, restoring, and protecting aquatic habitat has also become common in stormwater management manuals (Coffman, 2000; Hager, 2001; Urbonas et al., 1989). But no current manuals for stormwater design specifically present best management practices as a means to enhance the aesthetic, experiential attributes or other values in urban landscapes. Roesner and Brashear (1999) studied the content of existing stormwater management literature and reported that a number of design manuals have been developed to address the control of urban runoff for stormwater-quality and -quantity issues. However, they concluded that not only is there a considerable lack of information about what constitutes a properly designed stormwater management facility, but that there is also a complete lack of comprehensive design guidance for municipal planners and engineers that addresses public acceptance or perceived value as a design criteria.

The importance of designing stormwater-management facilities in a way that adds perceived value to a project or community is not a new concept. Beautifully designed detention ponds have always been recognized by developers and communities for their visual, recreational, and hence monetary value (Bookout et al., 1994; Ferguson & Debo, 1994; Tunney, 2000). Many new stormwater-treatment methods including bio-retention, vegetated swales and rain gardens are starting to be recognized for their ability to add beauty and perceived value to a community in part because of how these methods are being used in places such as Maplewood and Burnsville, Minnesota, to enhance the streetscapes (MPCA, 2005). A few authors have recognized that stormwater-treatment systems have the potential to add various and distinct design values to a project (Göransson, 1998; Wenk, 1998; Niemczynowicz, 1999; Thompson & Sorvig, 2000; Dreiseitl, Grau, & Ludwig, 2001; Dreiseitl & Grau, 2005). Under the leadership of William Thompson, *Landscape Architecture Magazine* has published many examples of artful rainwater designs that add value, (see, for example, Leccese, 1997; Thompson, 1999; Brown, 2001; Thompson, 2004; Echols & Pennypacker, 2006). But few studies have shown how non-hydrological stormwater management design attributes can add value. Two exceptions that stand out are: Peter Stahre's research showing how efforts in Malmö, Sweden, have created value, and literature from the United Kingdom based on SUDS (Sustainable Urban Drainage Systems) that address the developing amenity attributes of stormwater management design.

Peter Stahre has documented the variety of values in stormwater management, stating: "The characteristic feature of sustainable stormwater management is that quantity and quality issues are handled together with amenity" (2006). Stahre classifies the "positive values of open storm drainage" as aesthetic, biological, cultural, ecological, economic, technical, educational, environmental, historical, recreational, and resulting public relations (Figure 1).

The United Kingdom has recently introduced policies that include amenity factors in stormwater management as a key part of the "urban drainage triangle" (Figure 2).

Sustainable urban drainage regulations in the United Kingdom now require amenity to be evaluated equally with quality and quantity for all new drainage plans. Originally the amenity designation focused on creating added value in wildlife habitat and open space; however, SUDS revised the definition to include "community value, resource management (e.g., rainwater use), multi-use of space, education, water features, habitat creation, biodiversity action plans" (National SUDS Working Group, 2003).

Although these publications do offer new ideas that can add ideas for designers to consider when creating new stormwater management systems, they do not address specific project attributes or outcomes. This paper examines existing artful rainwater design projects in order to identify and clarify the specific stormwater management design attributes that can add value to a project and is an important contribution to stormwater design literature because of the potential for artful rainwater design to:

1. raise property values through attributes that could encourage developers to create stormwater-management facilities that surpass minimum requirements;
2. help policy planners and design review boards better understand the added value impact of

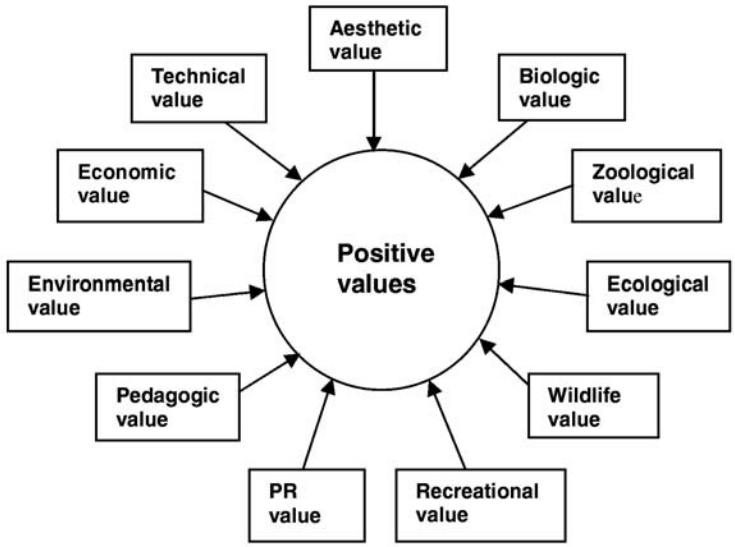


FIGURE 1. Positive Values of Open Storm Drainage (Stahre, 2006).

stormwater management, potentially offering guidance for revisions to existing regulations;
3. provide greater public exposure to, engagement in, and education about ecological stormwater issues for the protection of aquatic systems and clean water;
4. provide design strategies for integrating stormwater management throughout a site rather than the pursuing an "out of sight out of mind" approach; and
5. enhance the likelihood of regular maintenance by making stormwater management facilities a clear and visible added value.

RESEARCH METHODS

This research is an analysis of innovative projects and the observed project attributes revealing the added value of innovative and artful stormwater management. A few precedent-setting projects created by a relatively small number of design firms making use of new stormwater management strategies have demonstrated that designs of stormwater management systems has great potential to enhance public acceptance or perceived value. A list of projects from around the nation was developed by reviewing the past ten years of design awards presented by the American Society of Landscape Architects (ASLA, 1997-2007) and the American Institute of Architects (AIA/COTE, 1997-2007) for projects that clearly included stormwater management systems designed to create added value—i.e., increased value focused on stormwater management. Examples of exemplary rainwater design in the United States found in this first search include but are not limited to the work of:

Andropogon Associates, Ltd., Philadelphia, PA

Mayer/Reed. Portland, OR

Murase Associates, Portland, OR

Nelson Byrd Woltz, Charlottesville, VA

Olin Partnerships, Philadelphia, PA

Pierce County Environmental Service, Pierce County, OR

Portland Bureau of Environmental Services, Portland, OR

Seattle Public Utilities, Seattle, WA

Wenk Associates, Inc., Denver, CO

The designers of the projects that won American Society of Landscape Architects or American Institute of Architects awards along with leading educators, publishers, and experts in stormwater issues were asked to suggest other projects that best represented exemplary artful rainwater design. This process was continued until study participants no longer suggested additional projects and the projects most frequently suggested were included for consideration in this study. This process generated a list of twenty-one

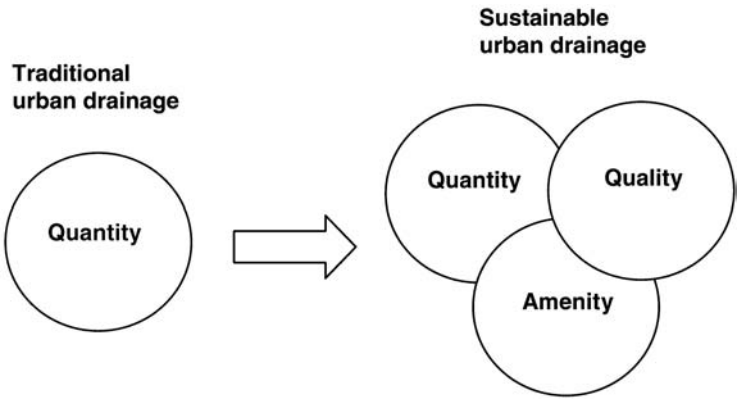


FIGURE 2. Development of more sustainable urban drainage systems and the "Urban Drainage Triangle" (CIRIA, 2001).

artful rainwater designs that represent a diversity of settings, project types and runoff treatment methods. The projects selected through this process are:

10th@Hoyt , Portland, OR

110 Cascade, Seattle, WA

Automated Trading Desk, Mount Pleasant, SC

Buckman Heights, Portland, OR

Cedar River Environmental Center, Cedar Falls, WA

Stephen Epler Hall , Portland, OR

Glencoe Elementary School, Portland, OR

Growing Vine, Seattle, WA

High Point Development, West Seattle, WA

Maplewood Rainwater Gardens, Maplewood, MI

Melrose Edge Streets , Seattle, WA

Seven Corners Market, Portland, OR

New Seasons Market, Portland, OR

Oregon Convention Center, Portland, OR

Oregon Museum of Science and Industry, Portland, OR

Outwash Basin at Stata Center MIT, Cambridge, MA

Pierce County Environmental Services, Chambers Creek, WA

Siskiyou Green Street Project, Portland, OR

SW 12th Avenue Green Street Project, Portland, OR

Water Pollution Control Laboratory, Portland, OR

Waterworks Garden, Seattle, WA

This selection process is admittedly biased by the publicity regarding and relative popularity of particular projects. Certainly, the process, based as it is on intentionally identifying information-oriented examples rather than random sampling, has likely overlooked many excellent projects because they were unknown to the study participants. This must be recognized and accepted as a necessary limitation of studying any evolving design subject. A second limitation in this selection of artful rainwater deigns is that most of the projects on this list are located in or near Seattle, Washington, and Portland, Oregon. This is likely a reflection of some combination of the nature of rainfall in these areas that may encourage designers to transform excess runoff from a common nuisance to a design asset and the establishment of strict stormwater regulations in these municipal regions. It is not surprising that most of the suggested artful rainwater design projects are in the U.S. Pacific Northwest; however, it is likely that many of the projects' attributes will prove adaptable for use in other regions.

A variety of information was gathered about each project using websites, published literature, telephone and in-person conversations with designers, and site visits to talk with local municipal officials and to gather additional project information as needed. The information for each project was documented using voice recordings, journal notes, drawings, on site sketches and photography. It was then collected, organized, reviewed, and analyzed to look for specific observed attributes in each project that related specifically to the stormwater management design. The preliminary analysis and resulting attribute list was based on this question: "What are the attributes of stormwater management design that enhance a project's

attractiveness or values?" The preliminary list yielded a wide variety of different project attributes, primarily because websites, interviewees, on-site signage and published articles often referred to the same project attributes using highly varying vocabulary. The list was then reduced by combining and categorizing the attributes from preliminary list based on differences and similarities. After constructing the second list, the information gathered for each project was reexamined to determine how or whether each observed attribute actually used stormwater management to create attractiveness or value as well as how well the attribute category and description fit. Attributes in specific projects that did not fit the categories and descriptions were reanalyzed, resulting in modification of the categories and descriptions or elimination of the attribute as "not a common attribute of stormwater management design that enhances a project's attractiveness or value." Each project was then reanalyzed to determine if each attribute category would be easily observed or if it were somewhat less observable due to the project design or other factors. This information was organized in a matrix to identify the common attributes observed in each study project and is presented in Table 1.

As can be seen in Table 1, the project attributes observed and presented in this research were not observed in every project. Nor does the list include all potential project attributes that could be observed by other researchers in artful rainwater design as is common in qualitative research. Rather this study is intended to present common project attributes that designers may use in their own artful rainwater designs to enhance a project's attractiveness or value.

There are assumptions and limitations in this study that should be acknowledged. First, and perhaps most significant, is the assumption that artful rainwater design is beneficial and desirable, and that any additional design, construction and maintenance effort and costs can be counterbalanced by value added. Second is the assumption that design critique by knowledgeable observers can derive useful understanding of value added. The third limitation is that added value consists of human appreciation as determined by conventional western aesthetics and values. A final limitation is that all the projects reviewed are located in the United States. While there is noteworthy work of artful rainwater design abroad, temporal and financial limitations restricted the project study sites in this research to the United States.

FINDINGS

The artful rainwater design projects analyzed in this study revealed that designers are using artful rainwater design to address stormwater-management issues while creating recognized amenities in the urban landscape—designs that invite visitors to explore, learn, and enjoy aesthetically pleasing landscapes that are publicly recognized as clear value added urban amenities. There are many lessons to be learned from existing works such as understanding which design factors contribute to a high level of public appreciation and acceptance. The project attributes most clearly observed through this study of artful rainwater designs are:

Ecological Legibility—communicates ecological and hydrological function

Maintenance Strategies—provides specific methods and guidance for upkeep

Information Systems—provides alternative media to raise stormwater awareness

Physical Accessibility—encourages people to see, touch or play with rainwater

Multiple Use—integrates multiple uses beyond stormwater treatment

Visual Integration—creates visual coherence between the form and function of a space

Public Awareness—demonstrates a community's existing knowledge about stormwater

Perceived Value—creates recognized added economic value

Municipal Commitment—creates positive agency action and inter- agency cooperation

The first six are observed design attributes that can be created by stormwater-treatment systems whereas the last three are observed community attributes that foster better stormwater design. Specific distinctions between design attributes and community attributes may not always be clear or relevant. For example, the community attributes of public awareness and perceived value can also be enhanced by designs that bluntly promote the importance of stormwater management. That

TABLE 1. Attributes observed in each study project.

Legend The artful rainwater design attribute directly relates to storm water management design and was easily observed in the project. ● YES ○ SOMEWHAT ☐ NO	Ecological Legibility	Maintenance Strategies	Information Systems	Physical Accessibility	Multiple Use	Visual Integration	Public Awareness	Perceived Value	Municipal Commitment
10th@Hoyt, Portland, OR	●	○		●	●	●	●	●	
110 Cascade, Seattle, WA	●	●	●	●	●	●	●	●	●
Automated Trading Desk, Mt. Pleasant, SC	●	○		●	○	●		●	
Buckman Heights, Portland, OR	○	○	○	●	●	●	●	●	○
Cedar River Environmental Center, Cedar Falls, WA	●	○	●	●	●	●	●	●	
Stephen Epler Hall, Portland, OR	●	●	○	●	●	●	●	●	○
Glencoe Elementary School, Portland, OR	●	●	●	●	●	●	●	○	●
Growing Vine, Seattle, WA	●	○	●	●	●	●	●	●	●
High Point Development, West Seattle, WA	●	●	●	●	●	●	●	●	●
Maplewood Rainwater Gardens, Maplewood, MI	○	●	●	●	●	●	●	●	●
Melrose Edge Streets, Seattle, WA	●	●	●	●	●	●	●	●	●
Seven Corners Market, Portland, OR	●	●	●	●	○	●	●	●	
New Seasons Market, Portland, OR	●	●	●	●	○	●	●	●	
Oregon Convention Center, Portland, OR	●	●	○	●	○	●	○	●	●
Oregon Museum of Science and Industry, Portland, OR	●	○	○	●		●	●	○	●
Outwash Basin at Stata Center MIT, Cambridge, MA					○	○		○	
Pierce Country Environmental, Chambers Creek, WA	●	●	●	●	●	●	●	●	●
Siskiyou Green Street Project, Portland, OR	●	●	●	●	●	●	●	●	●
SW 12th Avenue Green Street Project, Portland, OR	●	●	●	●	●	●	●	●	●
Water Pollution Control Laboratory, Portland, OR	●	○	○	●	●	●	○	○	●
Waterworks Garden, Seattle, WA	●	○	○	●	●	●	○	●	●

some attributes may be both design- and community-focused should not detract from their ability to enhance a project's attractiveness or value. The impact of the attributes can also be cyclical—for example, exemplary artful rainwater design may foster greater community recognition and support for stormwater management, thus fostering greater municipal commitment that in turn motivates designers to create more artful rainwater designs to stretch design beyond what has been achieved to date.

The project attributes are described further in this section with reference to selected examples from

specific projects. Only a few of the study projects are used as examples in the article, because this research is focused on the different project attributes that add value; it is not intended as a case study of individual artful rainwater design projects.

Ecological Legibility. Rainwater design can visually communicate ecological and hydrological function under various weather conditions and through seasonal changes. Respect for the immediate environs, as well as the environment in general, can be communicated and achieved in simple and appropriate ways; for example, the use of native plantings that will be able to withstand the conditions of the area, whether drought, frequent storms, etc. Likewise, the transient nature of water can be communicated with water-holding, filtering and infiltration facilities of various sizes to reflect different amounts of evapotranspiration, recharge, and discharge that would naturally have occured on the site before development. Even the choice of building materials and forms—for example local stone used to construct overhanging rock outcroppings as they appear in nearby streams—can be used to emulate the natural features and characteristics of local aquatic environments. An excellent example of ecological legibility is Stephen Epler Hall at Portland State University shown in Figures 3 and 4.

In this design by Mithun, the visible rainwater journey is particularly striking during rain events: water shoots down a five-story downspout and out into a rock-filled basin; it then overflows into a runnel that directs water across the courtyard and into a "biopaddy" (a sunken plant-filled basin). To ensure that people stop and enjoy the stormwater show, two benches are strategically placed to face the stormwater system. To make the experience even more inviting, the benches sit under a freestanding roof (great for

FIGURES 3 AND 4. Stephen Epler Hall at Portland State University.

use during the rain), and are backed by a wall to create an effective sense of "prospect and refuge." This design clearly encourages people to experience the artful rainwater story at Epler Hall.

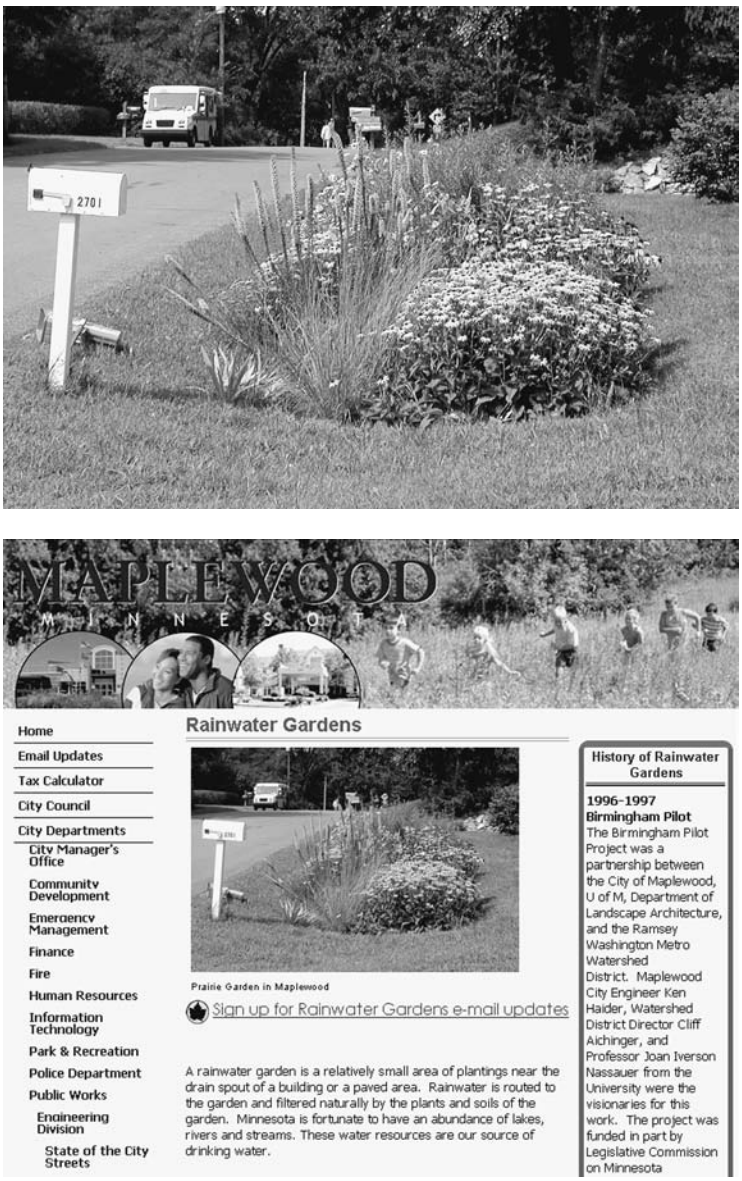
Maintenance Strategies. Rainwater designs need to include plans and specifications for both functional and visual upkeep or else they will not work or appear as intended, thus resulting in lower public acceptance and often lower property values. According to Paul Thomas, (2003) "Maintenance for landscapes that function as surface stormwater systems is different than typical park landscape care. Issues that must be addressed include: weed-related training and maintenance will be needed to deal with increase in weeds; clear, understandable edges for different landscape types are needed to guide maintenance staff on appropriate practices for each area; access must be provided for equipment needed to clean out facilities; and, maintenance practices will require assessment and modification as landscapes establish". An excellent example of maintenance strategies is SW 12th Avenue Green Street in Portland, Oregon, shown in Figures 5 and 6.

The SW 12th Avenue Green Street Project has received a national design award of honor from the American Society of Landscape Architects. Kevin Robert Perry, a Bureau of Environmental Services green street specialist, designed the innovative street stormwater project ledges at both ends of the bioretention facilities so that street debris is collected at a place where maintenance crews can easily use a simple flat shovel to remove it. Keeping the collection system on the surface and close to the sidewalk and street makes it obvious when cleaning is needed. Even the plantings are arranged in a neat grid making it easy to distinguish between the plants intended to stay and the weeds to be removed.

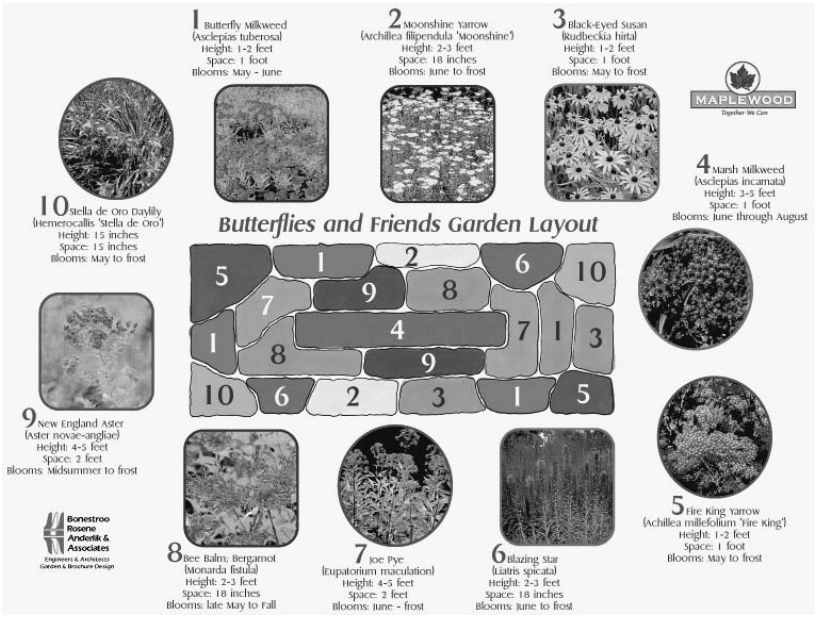
FIGURES 5 AND 6. 12th Avenue Green Street in Portland, Oregon.

Information Systems. Effective communication and education requires more than on-site signage. Websites, interpretive rainwater trails, fieldtrips, and other alternatives can raise community awareness of stormwater impacts with television advertising, newspaper and radio advertisements, displays, environmental programs for businesses, and stormwater ambassador programs for local schoolchildren. Rainwater design can be used as part of an integrated environmental awareness program. Such a program could include developing websites and ongoing design competitions to create comprehensive and continuing outreach-based strategies that facilitate community understanding of and thus the prevention of stormwater pollution. The municipality of Maplewood, Minnesota, provides an excellent example of information systems; it is shown in Figures 7, 8, 9, and 10.

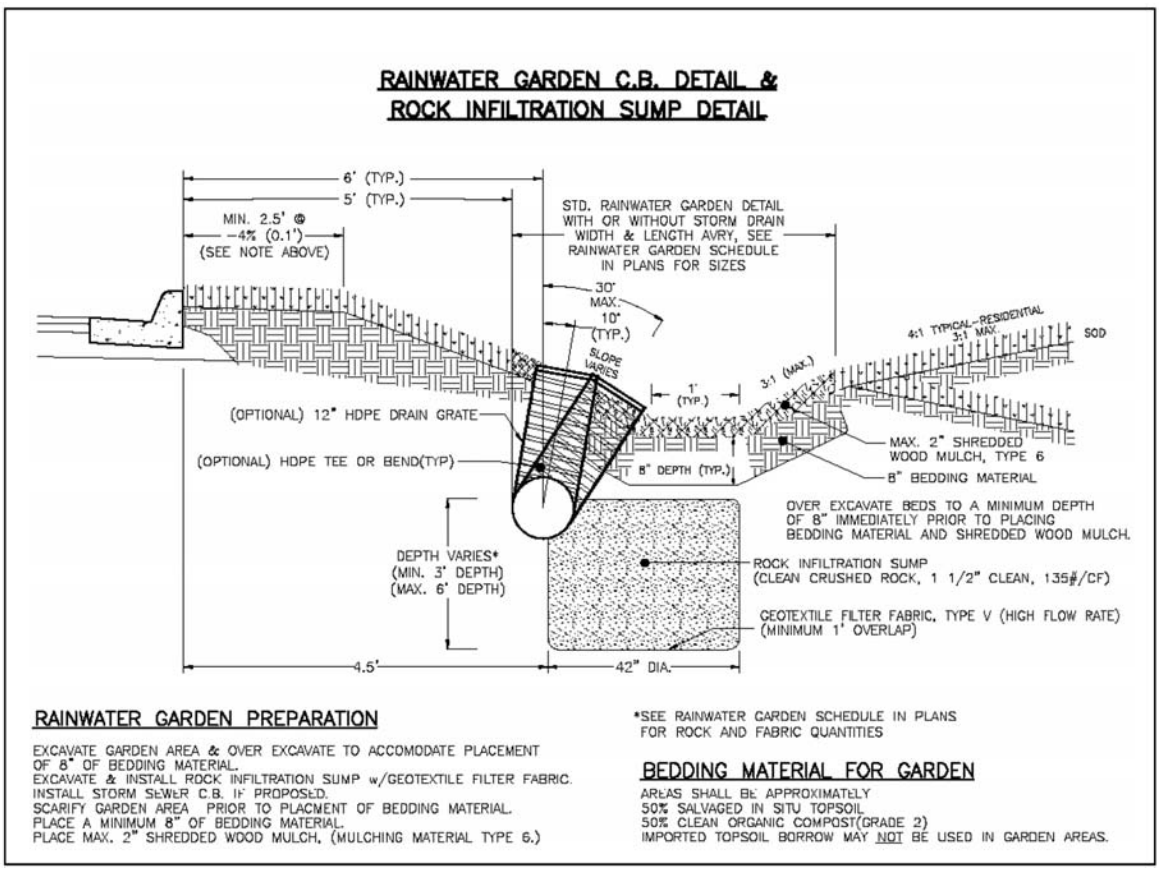
The Maplewood Rainwater Garden design by the City of Maplewood, Minnesota, working with designer Joan I. Nassauer (professor of landscape



FIGURES 7 AND 8. Maplewood Rainwater Gardens Information Systems—Online Photos and Web Page (Maplewood Minnesota Rainwater Gardens—web page).



FIGURES 9 AND 10.
Maplewood Rainwater Gardens Information Systems—Planting Plans and Planting Details (Maplewood Minnesota Rainwater Gardens—web page).



architecture at the University of Michigan) provides comprehensive information on the planning, design, construction, and long-term maintenance of raingardens built in Maplewood's residential neighborhoods. This information includes reports about public acceptance, design processes, recommended plants, soil preparation, and many other types of educational information that citizens can use to plan, design, install, and maintain rain gardens in their own communities. The information is offered in such a way that any community-minded group can learn everything needed to create similar rain gardens in their own towns.

Physical Accessibility. People want to see, touch, and play with water especially in urban environments on hot summer days. This realization is reflected in the works of Herbert Dreiseitl in which water design invites children and adults to interact and play with water and water systems. On the other hand, in response to liability fears most traditional stormwater management systems are intended to keep people away from and out of the water. Yet, rainwater design can be created in ways that foster interaction with water without creating safety concerns by simply splitting runoff into gentle shallow small flows and diverting the large flows safely away to appropriate locations. Such systems also allow the first flush to be easily diverted into infiltration and evapotranspiration facilities that more closely re-create a site's natural hydrological processes. Cedar River Watershed Education Center provides a compelling example of physical accessibility as shown in Figures 11 and 12.

The rainwater system at Cedar River Watershed Education Center is expressly designed to encourage visitors to see, hear, and touch the water. Rainwater is conveyed from the roof via downspout into a sculpted basin; from that point the water traverses a stone ter-

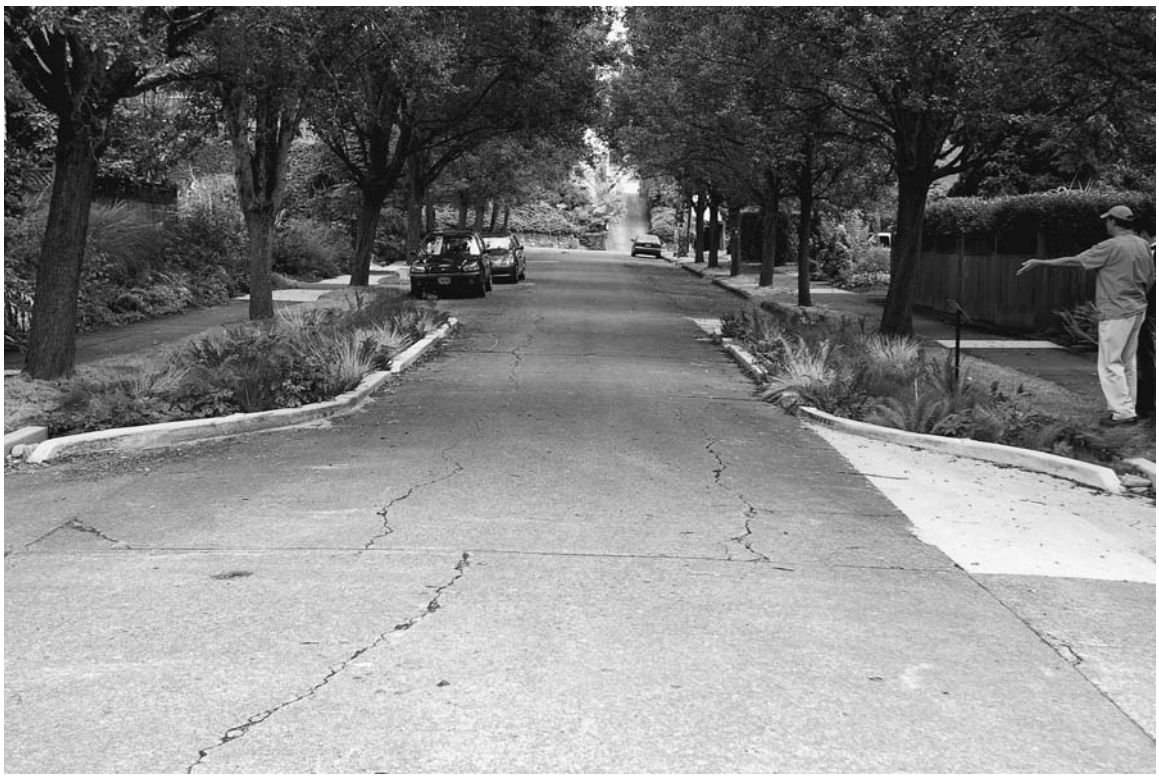
FIGURES 11 AND 12. Cedar River Watershed Education Center.

race in an elegantly meandering fashion. The water trail is clarified, enhanced, and made safe by a steel-grating cover perforated with gentle curves that extend the "liquid" theme, alternating with river pebble fill. Another physical accessibility opportunity is the Entry Court where stone steps are purposely designed to entice visitors to sit so as to watch and touch the water.

Multiple Use. Rainwater designs that integrate multiple uses will have greater public acceptance and add more value than designs that only provide stormwater treatment. Examples of multiple use include community play fields created in open space that also serves dry-detention purposes; accessible open water used for fishing and boating as well as retention; stormwater wetlands with boardwalks and viewing stands that protect the environment and serve educational purposes; and visual amenities provided when colorful bioretention plantings are incorporated into corporate and residential landscaping. Properties often gain in both visual appeal and financial value simply because they are located next to beautiful riparian buffers or stormwater wetlands. Quality of life is also improved when local walking trails, passive recreation or simple visual attractions create urban amenities that support greater social interaction. These multiple-use strategies enhance local land values, contribute to neighborhood revitalization, and protect regional environmental resources. An outstanding example of multiple use is the Siskiyou Green Street Project in a leafy residential neighborhood of Portland, Oregon, shown in Figure 13.

The Siskiyou Green Street Project could hardly be simpler or more effective. As shown in Figure 11, a stormwater curb extension "bump-out" is used to narrow a neighborhood street near an intersection and provide useable landscape area. The landscape is both richly planted with multi-textural sedges and ferns and is intersected by river rock dams and weirs. This simple project provides a wonderful example of

FIGURE 13. Siskiyou Green Stormwater Curbs with narrow driving lane to slow traffic.



multi-functionality—the extensions not only filter and slow stormwater runoff, they also serve as traffic-calming devices by narrowing the road. Moreover, the streetscape beautification is compatible with the area's residential plantings. In addition an opportunity for educating the public is also taken. The simple signage in the landscaped curb extensions offers brief text and simple graphics that show how the system works and what it accomplishes.

Visual Integration. Rainwater designs that visually fit with the existing and proposed form and function of a space will have greater public acceptance than designs that challenge visual expectations. The scale and character of open space, parks, and greenways is often quite different from that of downtown urban centers and plazas. Likewise, rainwater designs need to fit visually and culturally into the surrounding environment. For example, an aboveground corrugated steel tank used as a cistern may be visually appropriate when used as part of an environmental education program for a suburban Midwest school; however, it may look out of place in a New York urban business plaza. That is not to say that the visual impact of rainwater design could not contrast with the existing infrastructure, but rather that the visual impact needs to be considered in light of the local context. A particularly effective example of visual integration is the courtyard of 10th@Hoyt, an urban apartment courtyard in Portland, Oregon, shown in Figures 14 and 15.

The courtyard displays an understated orthogonal composition, and the materials, colors, and textures create an aura of subdued elegance appropriate for an upscale apartment building in Portland's Pearl District. The rainwater system is exposed as a water trail that is both unusual and consistent with the overall courtyard aesthetic. The system starts with a copper downspout running down the face of the five-story building, with rainwater from the downspout following an intriguing path along a stepped aqueduct, then dropping into a river rock–filled basin, before

FIGURES 14 AND 15. Courtyard at the 10th@Hoyt Apartments.

re-circuiting over Cor-ten fountains. Downspout-and-runnel systems in two other corners of the space present variations on the same theme. The entire distinctive composition is serene as well as captivating—it is perfectly appropriate design for this stylish apartment complex.

Public Awareness. Rainwater designs will be considered and implemented more often and with greater success in communities where there is an existing and robust understanding of stormwater issues and associated water-quality benefits. Stormwater management and design is now an essential component of almost every land-planning and site-design project. Although the public often believes that water-pollution problems come from industrial effluents, in many areas, up to 70% of the pollution in the streams, lakes, and rivers actually comes from non-point sources such as urban runoff (U.S. EPA, 1994). The effective placement, use, and maintenance of rainwater designs often require public participation and acceptance. However, the public is by no means always on board. Community acceptance of rainwater design often lags behind the new rainwater regulations; however, it has been suggested by municipal officials that innovative rainwater treatment can be more easily integrated into designs that enhance public awareness and demonstrate how design can complement and work with existing watershed and stormwater protection programs. Pierce County Environmental Services Facility in Chambers Creek, Washington, shown in Figures 16 and 17, presents a particularly effective public-awareness strategy that straightforwardly promotes the importance of stormwater management.

At the Pierce County Environmental Services Facility, the water trail is incorporated throughout the site and uses a variety of water-treatment approaches and design techniques. The trail begins on a corner of the building with a scupper discharging rainwater into a concrete spiral basin. Runoff from the basin flows into an adjacent wetland that visitors can explore from a curving boardwalk. Effective signage maximizes opportunities to heighten public awareness by explaining how the system diverts runoff into different conveyance/infiltration swales and by suggesting future treatment strategies. Making different rainwater treatment systems visible educates visitors in regard to stormwater treatment strategies, including the new methods for managing stormwater runoff.

FIGURES 16 AND 17. Pierce County Environmental Services Facility.

Perceived Value. Rainwater design will be considered and implemented much more often in communities or developments that understand the economic value of sustainable planning, design, and management. Profit need not be the only gain, however; in communities such as Village Homes, California, and Woodlands, Texas, the public readily accepts innovative stormwater design because over the years such environmental features have been shown to enhance resale values, as well as, the overall quality of life compared to other communities. Bookout et al. demonstrate how experiential and educational benefits also arise from a more varied and creative approach. It follows, then, that an imaginative approach to design can be a boon to developer and user alike. The connection between creative design approach and added value can clearly be seen in regard to rainwater design. Many past problems have arisen because conventional systems do not add value as a site amenity; instead they become financial liabilities to the owner and/or user, and further problems ensue as attention to maintenance lapses. Added costs of design and materials aside, it has been shown that creative and experiential land development design solutions add significant value to land development projects (Bookout et al., 1994). In this regard, perceived value has been created at High Point, a new neo-traditional residential community in West Seattle, shown in Figures 18 and 19.

The intent of adding perceived value is observed throughout the High Point design in elements that either market stormwater treatment as a community and ecological good or by bringing a sense of whimsy, enjoyment, and aesthetic pleasure to the appearance of its stormwater system. In regard to the former, an extensive signage system coupled with strategically located stormwater treatment facilities line every street right-of-way. In regard to the latter, water-related imagery is much in evidence_even the splash guards at the base downspouts are decorated with water relate designs, while decorative concrete castings of dragonflies adorn drain inlets. This combination of colorful, upbeat signage proclaiming the importance of the stormwater treatment systems and thematic gestures offered in an artful way make it impossible to miss

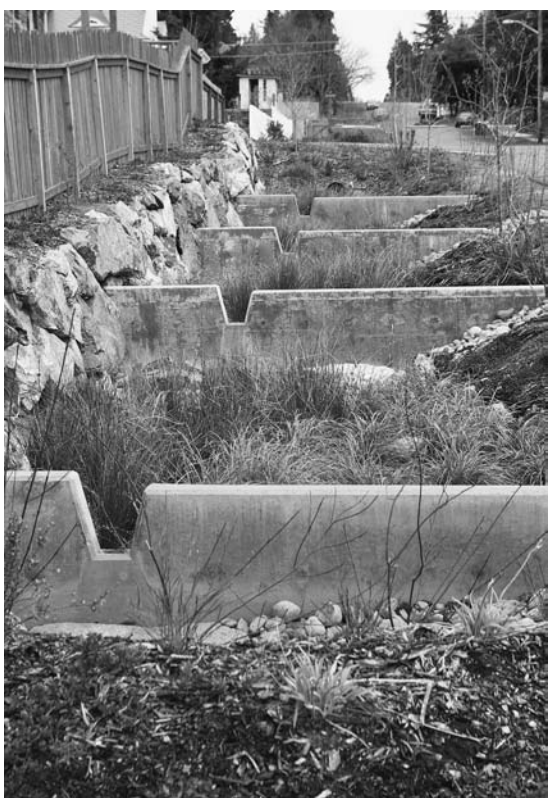
FIGURES 18 AND 19. High Point Residential Development Signage and Splash Blocks.

the message that this stormwater is of great value to this community.

Municipal Commitment. Rainwater designs are best developed as interdisciplinary projects supported in communities that provide inter-agency cooperation for planning, design and management, as well as, proactively overcoming or removing regulatory obstacles. For example, community regulations often require developers to pipe rainfall to a centrally located regional stormwater management facility; in addition, regulations may prohibit using untreated rainwater for non-potable uses in publicly accessible buildings. Thus many opportunities to create rainwater designs that could lower annual water use or reduce the cost of municipal stormwater management systems are summarily eliminated. To overcome these problems, local public works, planning departments, building regulators and utility companies need to work together to encourage greater rainwater design integration. Seattle Public Utilities has demonstrated exemplary municipal commitment through the Natural Drainage System Program. Part of Seattle's Natural Drainage System Program, the Street Edge Alternative program is based on retrofitting existing residential streets using plants, trees, and soils to clean runoff and manage stormwater flows, as shown in Figures 20 and 21.

The program started with the Street Edge Alternative on Melrose Avenue at a cost of $850,000 including an extensive design and communications budget due to the city's recognition of the need to work closely with local residents. The design was so successful at Melrose Avenue that Seattle Public Utilities has committed to retrofitting many more existing curb, swale, and pipe-drainage facilities in northern Seattle using natural systems to better manage runoff discharged into Puget Sound. Moreover, the city has recently implemented several other projects, including those at Melrose Avenue, Broadview Green Grid, High Point, and 110 Cascade (Seattle Public Utilities, 2007).

FIGURES 20 AND 21. Street Edge Alternatives at Melrose and 110 Cascade.



CONCLUSIONS

Rainwater management is a long standing concern for architects, landscape architects and engineers, one that will only be extended as development rates continue to rise and once-porous acreage is converted to impervious surface. Dealing with runoff is of paramount importance to property owners and developers who are faced with the challenges of managing rainwater on site. Stormwater design needs to be reconsidered and transformed from a reluctantly addressed, regulated requirement into a clear value-added component of good design. To help accomplish this, designers can seek out, examine, and learn from a collection of highly successful rainwater design examples that:

- provide inspiration and vision to make rainwater design a focal point of beautiful, interesting places to live and visit; and
- demonstrate rainwater design ideas that add tangible value to properties and encourage appropriate development investment.

There are many examples starting to appear around the country in which innovative designers and communities have recognized opportunities to use artful rainwater design project attributes to enhance a project's attractiveness or value. However, there are also many examples in which such opportunities have been missed. All of the study projects in this research successfully manage urban stormwater for the intended hydrological outcome. Some filter stormwater, reduce the frequency of excess runoff, and reuse stormwater for irrigation and non-potable use. Others use detention, infiltration, or bioretention to reduce peak flow rates and recharge ground water. However, it is one thing to divert rainwater to underground facilities such as filters and detention vaults, managing and disposing of stormwater as an unwanted waste product. It is another thing to address stormwater in environmentally responsible ways in order to ensure the ecological health of the rainwater's destination. And it is still a better thing to employ these methods as artful, expressive designs that call attention to rainwater in ways that create value. This study demonstrates that many designers have seized opportunities to combine beauty with practicality to address both long-term ecological outcomes and added value in the urban landscape. However, this study also found that some have not. For example, the Outwash Basin at Stata Center MIT in Cambridge, Massachusetts, is likely one of the most innovative stormwater-management designs in this country because of its ability to control peak flow rates, filter all stormwater runoff to a very high standard, recirculate stormwater to irrigate landscape and reuse filtered stormwater for non-potable use. Yet, many of the attributes identified in this study as creating value are not part of the Outwash Basin's design. The design does not allow the public to see or understand ecological and hydrological function; trash and weeds that collect in the basin can only be removed by hand; and people cannot see, touch, or play with the water. No information system exists to raise public awareness of stormwater issues and no account is given in site of the system itself. The only signage that existed at the time of the site visit was an 8'' × 11'' photocopied paper posted in the public restroom explaining how filtered stormwater is used in the building for flushing toilets and urinals. Fittingly enough, the entire stormwater management system is underground and out of sight. It has the benefit of not being unsightly, but it is a clear example of so many opportunities lost. Contrast this with the Siskiyou Green Street Project in Portland, Oregon, which is also an innovative stormwater management design, but for different reasons. This is a small project intended to capture, retain, and filter small-stormwater volumes and demonstrate how small, reversible non-threatening design interventions can be integrated into existing residential streetscapes (Liptan, 2005). The ecological and hydrological function can be easily understood because the system is built entirely above ground with a visible stormwater path, and the pollution is captured and clearly visible to the public and maintenance crews. Further, on-site signage includes Portland's Bureau of Environmental Services URL, which offers information about design, construction, and maintenance processes, as well as water-quality reports, construction documents, funding, and many other types of educational information. The project allows people to see, touch, and play with rainwater; fulfills a traffic-calming function; beautifies the streetscape in part because it integrates visually into the residential area; and educates the public regarding stormwater issues. Originally designed so that it could be removed if the residents

were not happy with the outcome, the system has met instead with public acceptance; other neighborhoods have asked Portland's Bureau of Environmental Services to construct similar projects on their streets—some have even offered to pay for the construction and maintenance costs themselves (Liptan, 2005).

Clearly there are opportunities for artful rainwater design to contribute to the quality of urban landscapes. However, additional design information and research is needed. Additional photographs and case study information regarding the artful rainwater designs discussed in this article, as well as others, is available at this website: www.artfulrainwaterdesign.net. Additional research is also needed to more specifically address these questions: Why does the public value artful rainwater design and what attributes are considered most desirable? What are the goals and objectives of stormwater management conceived as site amenity and what design techniques can designers use in their own "artful rainwater designs"? What are the special maintenance and management needs of artful rainwater design? How can current green-building rating systems be adapted to recognize the value of artful rainwater design? What are the life cycle costs and where are the best retrofit opportunities? And most importantly, how can we make sure that artful rainwater design ideas are considered early in the design phases of new projects?

> *Water is far from being just a designer's resource or a material: it begs to have its vital possibilities rediscovered. This starts at the beginning of the planning process . . . and involves linking up and integrating elemental themes.*
>
> —Dreiseitl et al. (2001)

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