Identifying a Standard Interpretive Symbol for Rain Gardens to Increase Perceived Value by the Public

by

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Abstract

Members of the American Planning Association (n=132) were surveyed for recommendations on what a standard minimum symbol should contain to adequately represent a rain garden storm water feature. Critiques, comments, and rankings for six symbol types containing various elements were gathered. Results indicate a strong preference for certain attributes, such as a water drop, plant forms, a basin, and a built element to be included. A consistent negative response was associated with an image of a water drop over a cupped leaf; a motif overused in representing a variety of "green" ideas. An inventory of 65 existing symbols for rain gardens was gathered through an internet search. Of 22 unique element types contained within the symbols, the water drop (46%), plant form (43%), and basin (41%) were used most often, indicating popular trends. The survey data suggests two elements alone are not sufficient to interpret rain gardens. This study shows that symbolizing a basin is as important to symbolizing water and plant forms. The combination of these three elements may be the best option for a base form of a standard minimum interpretive symbol for rain gardens.

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APA	American Planning Association
APGA	American Public Garden Association
EPA	Environmental Protection Agency
WTP	Willingness-to-Pay
AOI	Area of Interest
GSI	Green Stormwater Infrastructure

Introduction

More than a century ago Gertrude Jekyll, the noted British horticulturist, wrote of a "depression that collects the water from any storms of rain" (Jekyll, 1911). Whether it is called a stormwater runoff remediation site (DeBusk and Wynn, 2011), a bioretention mesocosm (Bakacs et al. 2013), or planted depression, a well planned rain garden by any description would be as effective (Nocco et al., 2016). The science supporting the benefits of green infrastructure installations has gained traction over the last few decades (Turk et al., 2017), and the installation of these practice sites has become a more regular (Sun and Hall, 2016), or required (Thurston et al., 2003), feature in landscapes and constructions. Curiously, there does not seem to be a concerted effort in interpreting sites such as rain gardens in a standard, minimum way so that at a glance any of these sites may be recognizable as, at the very least, an attempt at surface water runoff remediation, sediment and nutrient capture, and an area for slow absorption of water into the ground. Published literature on interrelated subjects of urban forestry, community planning, public perception and valuation, surface water runoff remediation, rain gardens, plant trialing, plant labeling, and consumer horticulture yield no shortage of clear excitement for the prospect of building a better world through smarter and more sustainable design.

Standard interpretation methods to signify the service sites as purposeful appear lacking. Major installations may display in depth interpretation in prime location sites, but these methods are not economically feasible in situations such as repeating curb cuts on city streets and parking lots, interstate on and off ramp basins, and residential installations. Moreover, certain green infrastructure installations, such as green roofs and green walls, may be self-explanatory as to their purpose, where others, such as rain gardens and bioswales, are at risk of seemingly becoming overgrown litter collection areas (Erickson et al., 2010). Though they are still

functioning properly by slowing surface water flow and capturing pollutants before they reach the storm drains or natural water courses, some in the public who do not realize their function may deem such sites as derelict, messy, and purposeless (Hoyle et al., 2017c). Interpretation has the power to brand such sites as being intentionally placed (Church, 2015).

This study proposed to first identify a low-to-zero reading level symbol for rain gardens that, through survey of members of the American Planning Association, proves to be self-explanatory of the function of the site. By using various basic forms in black and white the intent is to limit the amount of preference for stylized embellishment over clear idea transfer. Based on 65 symbols gathered from internet sources, the six symbols selected for this study represent various symbol types already in use in the United States, the European Union, Australia, and elsewhere. Some symbols include repeated attributes, such as depictions of clouds, rain drops, and basins. Others, such as a water drop over a leaf, are included in the survey because of their prevalence of use in various forms in publications with regard to green infrastructure, however lacking in substantive elements of interpretation they seem to be.

In addition to identifying preferred attributes to include in a standard minimum interpretive symbol, the attitudes of the participants were gathered including prior knowledge of rain gardens and opinions on adopting a standard minimum interpretive symbol for such. Work history, specialties, geographic locations, and estimated annual precipitation for their state were also collected. Finally, their demographic information was recorded for analysis of any trends in responses by groups. Through sampling the respondents (n=116) of American Planning Association (APA) membership for best recognition of proposed intent in three out of six design options, the data gathered regarding the efficacy of idea conveyance will have more of an assurance of credibility.

The goals are to make a recommended design open for public use, printable or easily redrawn, and with the negative space easily removed such that stencils can be made at very low cost. Through contacting in the APA, the American Public Garden Association, the Garden Club of America, the American Society for Horticulture Science, Auburn University, and North Carolina State University, among others, the goal is to start a movement toward using standardized interpretation for green infrastructure installations as has been done for gray infrastructure. In 1992, a movement began to stencil storm drains in Los Angeles with a sign that read "No Dumping, This Drains to the Ocean" accented with a symbolized fish skeleton. By 2015, there were 35,000 such interpretive symbols in that city and effects of that movement to educate the public can now be seen on storm drains across the United States (Smith, 2015). As has recently been done in New York City (New York City Department of Environmental Protection, 2017) where new green infrastructure installations are being branded with interpretation, we believe it is time to start such an educational effort for all of the green infrastructure installations.

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Literature Review

The literature review that follows covers why a standard minimum interpretive symbol for rain gardens is relevant, where it may be applied, by whom it may be adopted, and how to test for efficacy in improving the public opinion of rain garden sites in the presence of such a symbol. This review consists of published peer-reviewed articles in various horticulture, design, landscape architecture, and urban forestry journals, as well as feature length articles in industry-standard trade magazines.

Importance of Interpretation

Reports from a localized survey of Portland, Oregon residents include references to environmental learning attributed to interpretation accompanying rain gardens utilizing curb cuts in neighborhood green streets. Out of 42 respondents, 14 reported some level of skepticism about the functionality of the sites (Church, 2015). Residents are benefitting from an ecosystem service that slows street traffic, helps the local environment, and looks beautiful, but one-third of respondents reveal doubts about whether rain garden installations are necessary or effective. To include a detailed description of the science supporting use of rain gardens at each curb cut is not feasible; however, by stamping such sites with a type of official badge a passerby will have evidence that an installation is prescribed for that site (New York City Department of Environmental Protection, 2017) (Peirce et al., 1992).

"Interpretation" can be used in all fields to explain the same idea, i.e. that of explaining an idea. A foundational proponent for interpretation, Freeman Tilden (1883-1980), a reporter and fiction writer who became the National Parks interpretation champion, has become synonymous with interpreting nature for the benefit of the public. Tilden's book, Interpreting

our Heritage, has been cited thousands of times as a base for current understanding of interpretation as a philosophy. With the help of former National Parks Director Conrad Wirth, a directive regarding the basic philosophy for parks interpretation was drafted in 1953. The mandate: "Protection through appreciation, appreciation through understanding, and understanding through interpretation" led to the formation of the Division of Interpretation within the National Parks Service the following year (Tilden and Craig, 2009). The idea that the public will not protect what it does not understand is at the core of the argument for the point of this research. Further research into uses, applications, and public valuation improvement should yield insightful tools for measuring successful applications of interpretative elements for rain gardens.

A picture may be worth one thousand words, but a picture rich with imagery and detail takes more time to develop, is more costly to maintain when exposed to the elements, and is more costly to apply than are stamps and stencils. Through use of low-to-zero reading level ideograms, certain messages of function, warning, way-finding, purpose, and requirement become more universal in their scope of delivery and reception (Bosancic, 2016).

Though many commercial and public installations of rain gardens are designed with interpretation from their inception, the cost and level of detail in most will prevent such from being able to be incorporated at all design sophistication levels. Additionally, a detail-rich interpretative sign can convey deeper meaning and purpose, but must be seen, read, and understood by the reader to get the message across. While detailed installations are great resources for the people who can take the time to read and comprehend their message, by having ideas expressed in a higher reading level than zero such a sign would be excluding any participants who are not able to read the language in which it is written (Nawar, 2012).

Examples of international standards for simple interpretation exist throughout the world and help to convey meaning to persons of various abilities. A review of trends in interpretative designs in botanic gardens helps shed light on the interface between people, plants, and the environment. Of related concern in the study is the effect of sound ecosystem management practices that appear unappealing to the public, such as dead trees left as habitat (Villagra-Islas, 2011). Rain gardens will need maintenance to remove sediment, litter, and excess foliage due to the nature of their form and function (Erickson et al., 2010), but even so, public opinion of the site may be made higher through interpretation (Newburn and Alberini, 2016).

Symbols predate written language in most early civilizations and many continue to be interpretable with no additional context thousands of years after they were first created (Piercy, 2013). Many have the same meanings today that they did when they were first used (Alshenqeeti, 2016). Because there is as yet no accepted standard for rain gardens, an opportunity exists to identify one which should be interpretable for generations to come, no matter how languages may drift in time.

An international standard symbol can potentially be effective at educating billions of people about the purpose of the item, place, function, etc. for which they are thoughtfully designed. The adoption of the international symbol for access, i.e. the seated human figure in a wheelchair, is just one example (Guffey, 2015). In a semantographic symbol, there is no need for extra lines when the minimum is proven effective. Whether others choose to add embellishments to the excepted standard, the efficacy of the basic design should remain consistent. Another example of simple symbols put to use to educate the masses has its epicenter in Los Angeles, California, where the "NO DUMPING – THIS DRAINS TO THE OCEAN" stencils were first designed (Smith, 2015).

Blissymbols™ are a prime example of how fewer lines, but consistency in form, can help convey meaning to some of the public who are most challenged at communication. In the middle of the 20th century Charles K. Bliss created an international language of symbols that have been proven effective at bridging a communication pathway to persons with cerebral palsy such that after learning to interpret Blissymbols™ they are able to overlay other languages and learn to communicate through spoken and written language (Hetzroni et al., 2002). Through recombination of existing Blissymbols™ a basic form detailing functions and purpose of a rain garden is possible.

The European Environmental Agency understands the need for standardization for classifications of ecosystem services and has created CICES, the Common International Classification of Ecosystem Services as a tool for use in environmental accounting (Haines-Young and Potschin, 2018). Many of these standards have been codified into tokens for individual ecosystem services, but a summation of services for a rain garden in pictogrammic form is variable in certain cases (Ariluoma, 2016).

Public Valuation

Research on public valuation of aesthetic landscapes, water conserving practices, and perceptions of green infrastructure has shown trends in when, where, and how much more people are willing to pay for practices, installations, and products when they are labeled with interpretation of their reduced production costs, ecosystem service benefits, and benefits to the residential end user. Evidence was also found that participants who were asked to identify their environmental concerns as “egoistic”, “altruistic”, or “biospheric” were willing to pay premiums when the production method for plants was interpretable as sustainable (Khachatryan et al.,

2014). This is a case of consumer horticulture research hinting at the public's willingness to pay (WTP) for environmentally beneficial practices and products. However, many people may be more quick to adopt ecologically sound practices in their local communities when offered incentives from local government (Gmoser-Daskalakis, 2019).

Studies of hedonic pricing for urban green spaces in Poland indicate trends in real estate values with respect to proximity to green spaces of varying types and sizes (Czembrowski and Kronenberg, 2016). This echoes a study in Minnesota where similar results were found to recommend partial values attributed to ecosystem services and amenities (Sander & Haight, 2012). These types of studies are useful in informing how home buyers and selectors view different categories of green space, but they do not address the need to interpret the benefits to increase such values. Consumer preferences in the presence of interpretation of green spaces, such as rain gardens or wetlands, may yield further evidence for the necessity of inexpensive interpretation (Kaza and BenDor, 2013).

Public valuation of urban green space is a topic that has been explored in Sweden (Ode Sang et al., 2016) where reports indicate that younger resident respondents were notably less connected to the green spaces than older members of the population and that men were also less connected than were women. This could indicate a lack of understanding of the benefits of the green space to younger generations and reveal another opportunity to teach the public the inherent value of such spaces. A study of mental and physical health is useful as a general method for understanding public perception of green space as beneficial. The study looked at health in relation to green space types defined as urban green space, agricultural lands, forests, wetlands, and rangeland (Akpinar et al., 2016) and suggested this may be in line with the above use and valuation differences in generations and sexes where young people and male adults do

not associate green space with health, but women and older generations do see that connection. This study does not, however, look specifically at the relationships with regard to green spaces as ecosystem services in green infrastructure. Younger generations may respond differently regarding the value of such sites when considering them for other reasons than self-health (Zhang et al., 2015).

Public valuation of landscapes as quantified by discrete choice experiments was a focus of a study in Basque Country, Spain, for the European Landscape Convention because it allows policy makers to use statistical data to inform management and planning programs for the future of landscapes they are publicly mandated to protect and maintain. Through this effort researchers were able to determine the public's opinion of specific landscape types and quantify that promoting of native forests and organic farming, and development of recreation areas and cultural heritage could amount to €5.05 million and €4.35 million, respectively, in annual welfare benefits (de Ayala et al., 2015). The questionnaire provided the background information about the sites to the participants indicating a continuous need for interpretation to accurately determine actual valuation of landscape service sites.

Ecosystem Service

The term ecosystem service is used by many to identify the economic, cultural, and environmental value of practices that benefit the population through embracing the natural world within our designs of unnatural spaces (Sander and Haight, 2012). *Ecosystem Services*, the international journal for such, holds a wealth of information regarding the benefits of nature to the economies of the human species (Buchel and Frantzeskaki, 2015).

The term is also understood to describe what economic value a single tree can provide which means that we can define one tree as a service and determine its annual value, and inherent cultural value (Chen, 2015; Moore, 2016). This system of valuation has been used to label public trees with their individual value as a way of raising awareness. The idea of labeling trees is not new and has been suggested to raise public awareness and valuation for one hundred years (Hansen, 1920). Now we can accurately determine the monetary value from electricity saved on cooling, asphalt longevity, carbon offset, stormwater reduction, and soil stabilization to potentially include on the labels (McPherson et al., 2016; Wang et al., 2018).

The term has implications for benefits to both people and local ecologies when considering that food production for one species can also be food production for another (Clark and Nicholas, 2013). These urban green spaces have also been shown to provide value to low-income and rural populations in developing countries through the wood and shade they provide in the absence of electricity (Shackleton et al., 2015).

Residential gardens are also part of the urban forest and green infrastructure of a city, though they are not well researched as such (Inkiläinen et al., 2013). They help ameliorate the heat island effect and reduce runoff (Cameron et al., 2012). Through incorporation of rain gardens, these effects can be magnified even further on large scale installations, such as has been shown at the University of Cincinnati, with an estimate of 3,535,761,715 inches of stormwater runoff per year captured through their ReMEDiation program (Kusnier et al., 2016).

In fact, a study out of the UK measured gray versus green stormwater infrastructure installations by regret in the year 2050. Gray scenarios considered included separation of half of existing combined sewer system by retrofitting storm sewers, rehabilitation of the existing combined sewer pipes and expansion of centralized storage, and onsite treatment of wastewater

flows of half of new developments. Green strategies included storage and infiltration of half of road runoff through retrofit bioretention planters, disconnection of roof downspouts into retrofitted rain gardens, and installation of permeable pavers in residential driveways. Measuring impacts to sewer flooding, river flood risk, river dissolved oxygen, river ammonia, health and aesthetics, greenhouse gas emissions, cost, and acceptability, the practice that was suggested as causing the least regret in mid-century was the incorporation of residential rain gardens (Casal-Campos et al., 2015).

In countries where this type of research has been ongoing for decades the amount of ecosystem services provided by urban green space has become quantifiable (McPherson et al., 2013). Most large cities in developing countries have not been researched in this way. Many more urban areas can benefit from additions of ecosystem service sites, like rain gardens, and those benefits will extend to the rest of the global population through reduction of pollution of various types, including heat, sediment, and effluent organics (Dietz and Clausen, 2005). Research has now begun in certain large cities in South America, Africa, and Asia to quantify green spaces and map inequalities of their distributions (Escobedo et al., 2015a; Escobedo et al., 2015b; Lin et al., 2015).

A key factor in public valuation of ecosystem service sites is the plant material in use including the native status, realized longevity, and ultimate usefulness (Hoyle et al., 2017c; Hoyle et al., 2017a; Lanza and Stone, 2016; Nocco et al., 2016; Pandit et al., 2013; Schläpfer et al., 2015; Zhang and Jim, 2014). Aesthetics, or the beauty inherent in a landscape, comprise a large percentage of total value, but with labeling a more useful though less beautiful and even non-native design or species selection, can gain value in public opinion (Chen, 2015; Conway and Vander Vecht, 2015; Sjöman et al., 2016).

Research in the UK indicates that people respond more positively to the use of non-native plants in urban green spaces when informed of the plant's resilience to local effects of climate change (Hoyle et al., 2017b). However, this study sampled only people who were already at locations of public horticulture such as gardens, and thus are not a true sampling of the diversity of persons in the UK. Additionally, the researchers looked at public perception of various plant types in green spaces with trees, shrubs, and herbaceous plants all rated. (Hoyle et al., 2017a) Trends indicate that the herbaceous type of plantings were the most aesthetic to respondents, which has implications for rain garden research as many successful rain gardens incorporate heavy use of herbaceous material for ease of maintenance, leaf surface area at water level, and adaptability to survive both in times of drought and deluge.

Research has indicated that people will pay $0.08-0.15 more in an experimental auction for plants that have some characteristics that can be attributable to efforts or thoughts of sustainability (Yue et al., 2016). This allows for the assumption that the public will pay more, or attribute more value, for planting sites that they perceive to have similar ecological benefits. In terms of rain gardens, the public may be able to be taught to value what otherwise could be dismissed as a pit where litter collects in storm water runoff events instead of as a biological filter ahead of natural water courses.

Studies on public valuation of diversity as part of ecosystem service within green spaces have been conducted and findings indicate that the idea of diversity is a specifically cultural concept to most people (Voigt and Wurster, 2015). This language based assessment of landscapes indicates the stumbling block associated with meanings, or proposed benefits, as being mistranslated or misunderstood, and the importance for some lessons to be taught without words, but perhaps through imagery and symbolism only.

Resiliency, a term used extensively in the community planning discipline at large, seeks to redefine the end goal for planning efforts from thoughts of sustainability in practice and design toward creating practices that are robust and stalwart in the face of a changing climate, increasing population density, and the growth of the technological and industrial world (Church, 2015; Sjöman et al., 2016). Rain gardens are often part of the new recipes for resilient landscapes.

Studies conducted in Sweden indicate that urban spaces are ideal to introduce the benefits of ecosystem services to the public, no matter their previous understanding of the science behind its benefit. The review concluded that more research was needed to understand people's perceptions of cultural ecosystem services in order for more of such systems to continue to be incorporated within the development and redevelopment of our cities (Andersson et al., 2015).

A study of public perception of words such as "eco-friendly" and "sustainable" conducted in Michigan and Texas can help to inform marketers of products that can be attributed using either term and in relation to regulated terms such as organic and local. The study warns of meanings becoming eroded for all due to the newness of the term eco-friendly (Campbell et al., 2015). A similar risk must be considered with the adoption of a standard symbol for rain gardens because some percentage of these sites will always function less optimally than others. When a standard symbol is branded on two sites within view of each other and one is clearly not working or is in need of maintenance, the badge may become one not of educational interpretation, but one perceived as ineffective, or worse, misleading.

A study from 2012 revealed the carbon and pollution offsets by urban forest types in Auburn, Alabama as a means to interpret value to the green spaces (Martin et al., 2012). This article gives utterance to storm water capture as an ecosystem service but does not include it in

the valuation study. An urban forest designed with rain gardens may prove more valuable empirically but might not raise public valuation without proper interpretation.

A study in France and Portugal canvassed residents in regards to their beliefs about the benefits of urban green space in order to help guide planners in their task of creating the type of green city that their residents desire (Madureira et al., 2015). This study does not include surface water absorption as a listed benefit of urban green spaces, which allows for opportunities to discover more about public opinion of such. Furthermore, it stresses the need for open communication between planners and citizens to preempt backlash from the public in regards to decisions they have not been taught to appreciate.

With more cities encouraging their residents to incorporate storm water remediation practices through incentives (Fletcher, 2009) (Thurston et al., 2003), free product giveaways (Thurston, et al., 2008), and educational materials ("NC DEQ: Stormwater Design Manual," 2017) researchers seek to quantify the amount of water actually removed from the stormwater systems in various locations across the US to determine whether the same design can be equally effective in all areas by using a three year simulation (Jennings, 2016). These empirical data can be helpful in community-wide education events or publications when introducing citizens to novel approaches to water management.

Consideration must be given to those citizens whose ideals are not in line with thoughts of resiliency, sustainability, and best ecological practices. One study out of Canada addresses ecosystem "disservices" that occur when green infrastructure can be said to have caused harm to individual property owners; in this case from damage following an ice storm (Conway and Yip, 2016). People are much attuned to the cost associated with clean up efforts but are not always able to balance those costs with the more passive benefits of green infrastructure in their own

yards (Hoyle et al., 2017c). This is yet another example of how a lack of proper interpretation weighs on potential public valuation of green infrastructure.

However, some members of the community do engage with green infrastructure whether in their local parks or urban areas to the extent that research has been conducted on the ramifications of a future with more citizen management areas of urban forests (Mattijssen et al., 2017). An engaged constituency would be ready for active participation not only in productive labor (Molin and Konijnendijk van den Bosch, 2014), but also in actively educating others about the positive effect they can have on their local environments (Brauer, 2017).

A guide to understanding the deeper values that people place on urban forests and green spaces has been formed from meta-analysis of data of more than 1,200 participants in Canada and Columbia. This study combined seven data sets to examine the correlations of responses in order to more fully understand the general public opinion in this regard (Ordóñez et al., 2017). The researchers report that previous studies are lacking in open-ended questions that could allow a respondent more opportunity to expound on what they value about urban forests. Cultural services of green space vary from group to group, but all can be made more appreciative of such spaces if taught the benefits it yields outside of their existing knowledge base.

A review of more than 100 studies in North America analyses and interprets the findings within each, what trends they reveal, and where future researchers might look to fill the gaps in the literature with respect to cultural ecosystem services valuation by the public (Nesbitt et al., 2017). This also includes property values, tourism, and local economies and businesses as indicators of public appreciation of green space as sources of ecosystem services. Economic benefits of rain gardens as part of the urban forest were not considered, though they have been proven to help mitigate storm water runoff and reduce flooding and strain of sewage systems

(Tang et al., 2016). Implications for tourism in cities subject to flooding, such as coastal cities and historic cities not engineered to handle current amounts of runoff from impervious surfaces, are striking (DeBusk and Wynn, 2011).

Behavior Analysis

To determine the usefulness of eye tracking technology in consumer behavior analysis for individual plant purchases researchers compelled participants to engage with a screen and have their eye movements, gaze duration, and overall time spent with images of plants with and without interpretation assessed (Behe et al., 2015). This study sheds light on valuation of plants with interpretive signage but does not extend the study into the landscape.

Eye-tracking technology is being utilized to understand human behavior and reactions to various interventions, but the studies related to this field of research are limited to consumer horticulture at present (Behe et al., 2014). This technique could be used in a valuation experiment by revealing what, where, when, and for how long people consider an interpretive element in a rain garden, and how that affects their perception of the site in the presence or absence of an interpretive symbol.

Gaze Analysis researchers in various fields are utilizing eye-tracking technology for marketing and consumer trends, truth in valuation responses, geocognition, and etc. More uses of this type of data gathering are presumed and tested each year. This provides a quantitative lens through which to analyze qualitative data. Researchers used eye movement in a Discrete Choice Experiment regarding water conservation related to ornamental plant selection and found that people who read left to right stop their gaze the top left panel in a grid first, stay there longest, and preferentially choose the plant in that location more often. Additionally, while no

premium was paid for plants that were labeled as grown with reduced water use, a premium was paid for plants labeled to use less water once in the landscape (Palma et al., 2016). This indicates that the public may respond positively to landscape practices, such as rain gardens, when they are taught the water conserving benefits of the practice. It also hints at the placement of standard interpretation in landscapes as being a component to added public valuation.

People tend to fear or be distrustful of things that they do not understand. Through education, fear and distrust are abated and deeper understanding can be possible (Whitehurst and Howells, 2006). In the literature, evidence shows that many members of the public respond well to knowing that they are either helping the environment more or at least harming it less (Yue et al., 2011), on a personal scale (King et al., 2015). Through the use of rain gardens, people can be participating in an ecosystem service at each moment after installation, and become part of the conversation about the deleterious human impacts to the environment and what each may do to curb their own impacts.

This research seeks to improve the general opinion by the public upon interpretation of otherwise less sophisticated rain garden designs using a simple and standard symbol to convey the function of the site using no text. It is thought that through the use of the identified symbol those in the population who do not know the purpose of such installations will have a better understanding through seeing a self-explanatory symbol branded on-site. When more people begin to understand and place value on the function of these sites more momentum for the installation and use of them should occur.

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Chapter 3
Rain Garden Symbol Survey to the American Planning Association

Abstract

Members of the American Planning Association (n=132) were surveyed for recommendations on what a standard minimum symbol should contain to adequately represent a rain garden storm water feature. Critiques, comments, and rankings for six symbol types containing various elements were gathered. Results indicate a strong preference for certain attributes, such as a water drop, plant forms, a basin, and a built element to be included. A consistent negative response was associated with an image of a water drop over a cupped leaf; a motif overused in representing a variety of "green" ideas. The survey data suggests two elements alone are not sufficient to describe rain gardens. The addition of a third element, the basin, is recommended for the base form of a standard minimum interpretive symbol for rain gardens.

Introduction

The science supporting the benefits of green infrastructure installations has gained traction over the last few decades (Turk et al., 2017), and the installation of such practice sites is becoming a more regular (Sun and Hall, 2016), or required (Thurston et al., 2003), feature in landscapes and constructions. Curiously, there does not seem to be a concerted effort in interpreting sites such as rain gardens in a standard, minimum way. A standard minimum should be present so that, at a glance, any of these sites may be recognizable as, at the very least, an attempt at surface water runoff remediation, sediment and nutrient capture, and an area for

absorption of water into the ground. The published literature on the interrelated subjects of urban forestry, community planning, public perception and valuation, surface water runoff remediation, rain gardens, plant trialing, plant labeling, and consumer horticulture yield no shortage of clear excitement for the prospect of building a better world through smarter and more sustainable design.

Standard interpretation methods to signify these sites as functioning and purposeful ecosystem service sites appear lacking. Major installations may display in depth interpretation in prime sites, but such methods are not economically feasible in situations such as repeating curb cuts on city streets and parking lots, interstate on and off ramp basins, and residential installations. Moreover, certain green infrastructure installations, such as green roofs and green walls may be self-explanatory as to their purpose, where others, such as rain gardens and bioswales, are at risk of seemingly becoming overgrown litter collection points (Erickson et al., 2010). Though they are still functioning properly by slowing surface water flow and capturing pollutants before they reach the storm drains or natural water courses, some in the public who do not realize their function may deem such sites as derelict, messy, and purposeless (Hoyle et al., 2017c). Interpretation has the power to brand such sites as being intentionally placed (Church, 2015).

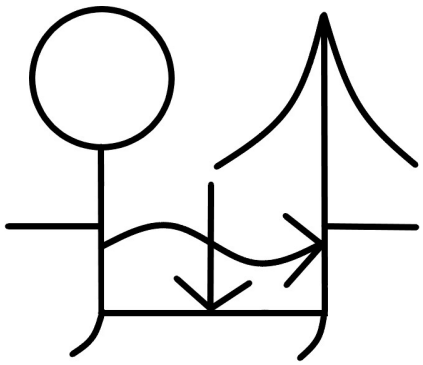
A picture may be worth one thousand words, but pictures rich with imagery and detail take more time to develop, are more costly to maintain when exposed to the elements, and are more costly to install than are stamps and stenciled designs. Through the use of low to zero reading level ideograms, messages of function, warning, way finding, purpose, and requirement become more universal in their scope of delivery and reception (Bosancic, 2016). Symbols predate written language in most early civilizations and many continue to be interpretable with

no additional context thousands of years after they were first created (Piercy, 2013). Many symbols have the same meanings today that they did when they were first used (Alshenqeeti, 2016). As no accepted standard symbol for rain gardens yet exists, an opportunity to identify one which should be interpretable for generations to come, no matter how languages may drift in time, presents itself.

Examples of international standards for simple interpretation exist throughout the world and help to convey meaning to persons of various abilities. An international standard symbol can potentially be effective at educating billions of people about the purpose of the item, place, function, etc. for which they are thoughtfully designed. The adoption of the international symbol for access, i.e. the seated human figure in a wheelchair, is just one example (Guffey, 2015). In a semantographic symbol, there is no need for extra lines when the minimum is proven effective. Whether others choose to add embellishments to the excepted standard, or not, the efficacy of the basic design should remain consistent.

Blissymbols™ are a prime example of how fewer lines, but consistency in form, can help convey meaning to some of the public who are most challenged at communication. In the middle of the 20th century, Charles K. Bliss created an international language of symbols that have been proven effective at bridging a communication pathway to persons with cerebral palsy such that after learning to interpret Blissymbols™, they are able to overlay other languages and learn to communicate through spoken and written language (Hetzroni et al., 2002). Through recombination of existing Blissymbols™ a basic form detailing functions and purpose of a rain garden is possible and was a starting point for this research. Below is an amalgam of Blissymbols™ arranged to represent a rain garden.

Figure 3.1 Proposed combination in Blissymbols™ of Flower and Tree above the Earth Line, and Rain, Water and Roots in a Basin, to represent rain gardens.



"Interpretation" can be used in all fields to explain the same idea, i.e. that of explaining an idea. A foundational proponent for interpretation, Freeman Tilden (1883-1980), National Parks interpretation champion, has become synonymous with interpreting nature for the benefit of the public. Tilden's book, Interpreting our Heritage, has been cited thousands of times as a base for current understanding of interpretation as a philosophy. With the help of former National Parks Director Conrad Wirth, a directive regarding the basic philosophy for parks interpretation was drafted in 1953. The mandate: "Protection through appreciation, appreciation through understanding, and understanding through interpretation" caused the Division of Interpretation to be formed within the National Parks Service the following year (Tilden and Craig, 2009). The idea that the public will not protect what it does not understand is at the core of the argument for the point of this research.

A review of trends in interpretative designs in botanic gardens helps shed light on the interface between people, plants, and the environment. Of related concern in this study is the effect of sound ecosystem management practices that appear unappealing to the public, such as dead trees purposely left as wildlife habitat (Villagra-Islas, 2011). People tend to fear or be distrustful of things that they do not understand. Through education, fear and distrust are abated

and deeper understanding can be possible (Whitehurst and Howells, 2006). In the literature, evidence shows that the public responds well to knowing that they are either helping the environment more (Yue et al., 2016), or at least harming it less, on a personal scale (Palma, et al., 2016). Through the use of rain gardens people can be participating in an ecosystem service at each moment after installation (Mattijssen et al., 2017), and become part of the conversation about the deleterious human impacts to the environment and what each may do to curb their own impacts (Greene et al., 2011). Rain gardens need maintenance to remove sediment, litter, and excess foliage due to the nature of their form and function (Davis et al., 2009; Tang et al., 2016), but even so, public opinion of the site may be made higher through interpretation (Church, 2015). Though many commercial and public installations of rain gardens are designed with interpretation from their inception, the cost and level of detail in most will prevent them from being able to be incorporated at all design sophistication levels, such as in residential installations, which are an important part of the urban landscape (Cameron et al., 2012). Additionally, a detail-rich interpretative sign can convey deeper meaning and purpose, but must be seen, read, and understood by the reader to get the message across. While these installations are great resources for the people who can take the time to read and comprehend the message, by having ideas expressed in a higher reading level than zero such signs are excluding any participants who are not able to read the language in which they are written (Nawar, 2012).

Findings from a survey of Portland, OR, residents include references to environmental learning attributed to interpretation accompanying rain gardens utilizing curb cuts in neighborhood green streets. Out of 42 respondents, 14 reported some level of skepticism about the functionality of the sites (Church, 2015). These residents are benefitting from an ecosystem service that slows street traffic, helps their local environment, and looks beautiful, but one-third

of the respondents reveal doubts about whether the installations are necessary or effective. It is not feasible to include a detailed description of the science supporting the use of rain gardens at each curb cut; however, by stamping such sites with a type of official badge, as has recently been done in New York City, NY (New York City Department of Environmental Protection, 2017), a passerby will have evidence that an installation is prescribed for that site (Peirce et al., 1992).

Consideration must be given to those citizens whose ideals are not in line with thoughts of resiliency, sustainability, and best ecological practices. "Disservices" that occur when green infrastructure can be said to have caused harm or inconvenience to individual property owners will weigh heavily, as people are much attuned to the cost associated with clean up efforts (Conway and Yip, 2016), but are not always able to balance those costs with the more passive benefits of green infrastructure in their own yards (Hoyle et al., 2017c). This is yet another example of how a lack of proper interpretation weighs on potential public valuation of green infrastructure.

However, some members of the community do engage with green infrastructure whether in their local parks or urban areas to the extent that research has been conducted on the ramifications of a future with more citizen management areas of urban forests (Mattijssen et al., 2017). An engaged constituency would be ready for active participation not only in productive labor (Molin and Konijnendijk van den Bosch, 2014), but also in actively educating others about the positive effect they can have on their local environments (Brauer, 2017).

With more cities encouraging residents to incorporate storm water remediation practices through incentives (Fletcher, 2009; Newburn and Alberini, 2016; Thurston et al., 2003), free product giveaways (Thurston et al., 2008), and educational materials ("NC DEQ: Stormwater Design Manual," 2017) researchers seek to quantify the amount of water actually removed from

the stormwater systems in various locations (Jennings, 2016). These empirical data can be helpful in community-wide education events or publications when introducing citizens to novel approaches to water management ("The NSS hits the streets #1: Price Tag the City," 2017).

Studies conducted in Sweden indicate that urban spaces are ideal to introduce the benefits of ecosystem services to the public, no matter their previous understanding of the science behind its benefit. The review concluded that more research was needed to understand people's perceptions of cultural ecosystem services in order for more of such systems to continue to be incorporated within the development and redevelopment of our cities (Andersson et al., 2015).

A review of more than 100 studies in North America analyses and interprets the findings within each, what trends they reveal, and where future researchers might look to fill the gaps in the literature with respect to cultural ecosystem services valuation by the public (Nesbitt et al., 2017). This also includes property values, tourism, and local economies and businesses as indicators of public appreciation of green space as sources of ecosystem services. Economic benefits of rain gardens as part of the urban forest were not considered, though they have been proven to help mitigate storm water runoff and reduce flooding and strain of sewage systems (Tang et al., 2016). Implications for tourism in cities subject to flooding, such as coastal cities and historic cities not engineered to handle current amounts of runoff from impervious surfaces are striking (DeBusk and Wynn, 2011).

Context and Methods

In reviewing governmental, municipal and societal web pages and publications related to rain gardens we became aware that there was little consistency to the designs of the symbols that

would accompany the text and photographs for rain gardens. In traveling to various public gardens and new constructions with an eye for stormwater runoff remediation and its interpretation there was still no consistent symbol demarking the sites if any symbol or interpretation was present at all. This led to the question of whether there should be one standard interpretive symbol vetted and introduced. Such a symbol would need to be more than a mere hint at something "green" as so many of the options in use could be called. It would need to be more than a hint at something having to do with water, as well. It was our assumption that if a symbol could be identified that could be self-explanatory and easily recreated, stamped or stenciled on rain garden sites, it would help raise awareness of the purpose of the sites it accompanied, and therefore increase the perceived value by the public.

By creating an assortment of six design options shown below, which were combinations of symbol types already in use as found in our companion analysis inventory, a vetting could commence. These were pared down to basic form and shown in black and white to limit bias for embellishment and focus attention on idea transfer.

Figure 3.2 Proposed symbol CLOUD to represent rain garden in survey to American Planning Association participants.

Figure 3.3 Proposed symbol LEAF to represent a rain garden in a survey to American Planning Association participants.

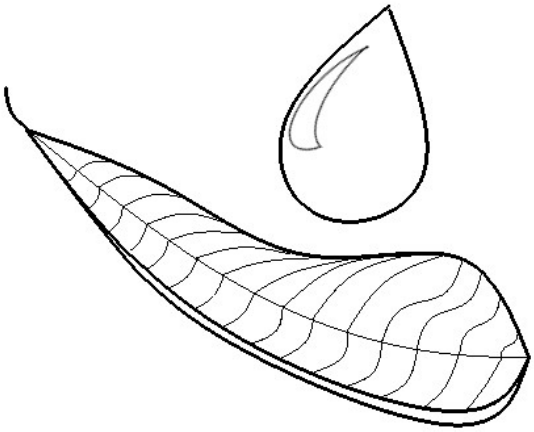


Figure 3.4 Proposed symbol DROP to represent a rain garden in a survey to American Planning Association participants.

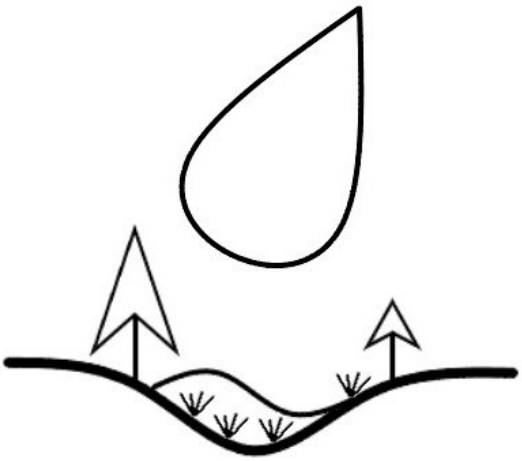


Figure 3.5 Proposed symbol UMBRELLA to represent a rain garden in a survey to American Planning Association participants.

Figure 3.6 Proposed symbol CITY to represent a rain garden in a survey to American Planning Association participants.

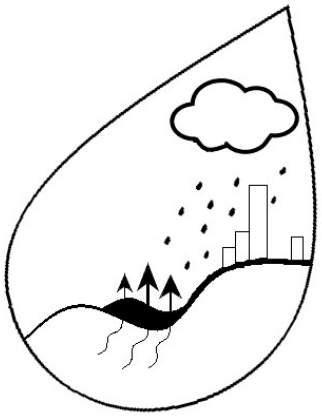
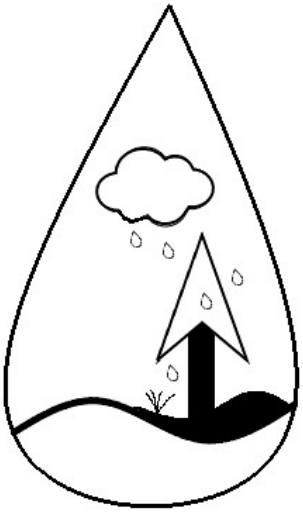


Figure 3.7 Proposed symbol TREE to represent a rain garden in a survey to American Planning Association participants.



Permission was gained by contacting the American Planning Association (APA) to survey their membership. APA consists of 38,818 members across the country, and working internationally, as the community, city, and regional planners of various disciplines and specialties. They were chosen because of their expertise and authority on engaging with, and interpreting urban environments to, the public. To determine participant's tenure and

specializations in the field, their previous knowledge regarding rain gardens, their willingness to encourage the use of a standard minimum symbol for such, and their ranking and critiques of the options shown, a survey using Qualtrics™ was designed. Additional demographic information was solicited to be used in analysis of results of ranking to see if any trends in responses would be revealed.

APA allowed their constituents to be surveyed passively, through an embedded link in the "Opportunities" section at the end of their biweekly emailed newsletter, *APA Interact*, published on August 28th, 2019, and to be open for one month. The survey began by giving a basic description with intended function of a rain garden, then showing a drawing of a section view, with diagrammatic text, of a rain garden. Participants were asked about their familiarity with the concept of a rain garden and whether they knew of any in their communities. They were reminded of the now commonly seen storm drain stamps that teach passersby where the drain empties, and then were asked if they would encourage the use of a standard minimum interpretive symbol for rain gardens if it was proven effective at idea transfer. If they indicated they would not they were given an opportunity to explain why not. Next, they were given the high and low annual state-wide national averages for precipitation and then asked to indicate the average in their home communities. This would allow us to check their knowledge about their state's (or territory's) rainfall in correlation to their attitude about rain gardens.

In the following section the participants were asked to look at the six symbols, which would appear in random order, and to not judge them as attempts at fine art, but only begin thinking about which was more effective at idea transfer. Then, again displayed in random order, they were asked to rank the selections from the best, #1, to the worst, #6, option. The participants were told at this point that they would have the opportunity to critique their top three

selections in the following slide. Having interest in the lower ranking selections as well as the upper, the survey was designed such that all selections had to have a unique rank before the participant could continue.

The third, second, and first choices were then displayed and the participant could click on areas of interest (AOI) that had been preset for each symbol. The AOIs were boxes around key attributes in each symbol that would be displayed as the participant's cursor hovered over each area. One click of the mouse put a green highlight to the box with a check mark, two clicks gave a red highlight with an X mark, and three clicks returned the box to neutral. This function allowed for a participant to select and critique their top choices and draw specific attention to attributes they were strongly in support of, or against. They also had opportunity to write their critiques for each of the top three, if desired, which allowed them to articulate their thoughts and expound on their reasoning. Because these symbols are by no means concrete and immutable forms, suggestion in how respondents might recommend changing any part of each were of interest.

Finally, the participants were asked to report about themselves. One question allowed them to select as many specializations in planning with which they identified, whether through study or work and how many years they had been in the profession. They could then indicate their localities by state or type the answer to where in the world they worked or were studying. Following this, their demographic information related to sex, race and ethnicity, age, and level of education was asked. Participant's native language and any other languages in which they professed fluency were assessed to see if any trends would be revealed in symbol selections by language. After the survey closed the data were analyzed using IBM SPSS Statistics™ version 26 for descriptive statistics, frequencies, and trends in responses.

Results

Of the 38,818 members who were emailed the newsletter, 14,246 opened the email, and of those, 132 readers began to participate in our survey. In total, 116 cast their votes on the symbols, giving a response rate of 0.8%. Though the response rate was less than one percent, soliciting engagement from such a vast pool of potential participants allowed the survey to receive responses from a wide array of demographic types from all across the country, and into Canada.

Table 3.1 American Planning Association participating member's selections for their place in the field of planning.

	N
I work in the Private Sector	25
I work in the Public Sector	70
I am an Educator/ Researcher	5
I work for Non-Profit organizations	11
I am a Student	12
I am Retired	2

Table 3.2 American Planning Association participating members self-selected specializations in the field of planning.

	N
Community Activism/ Empowerment	17
Community Development	54
Comprehensive/ Long-Range Planning	51
Economic Development	26
Education	4
Environmental/ Natural Resources Planning	49
Food Systems Planning	15
Hazard Mitigation/ Disaster Recovery Planning	30
Historic Preservation	20
Housing	20
Landscape Architecture	19
Land Use and Code Enforcement	45
Planning Law	12
Parks & Recreation	29
Planning Management/ Finance	8
Transportation Planning	36
Urban Design	33
Prefer to Self Describe	3

Figure 3.8 American Planning Association participant's response to state location of work/study/live.

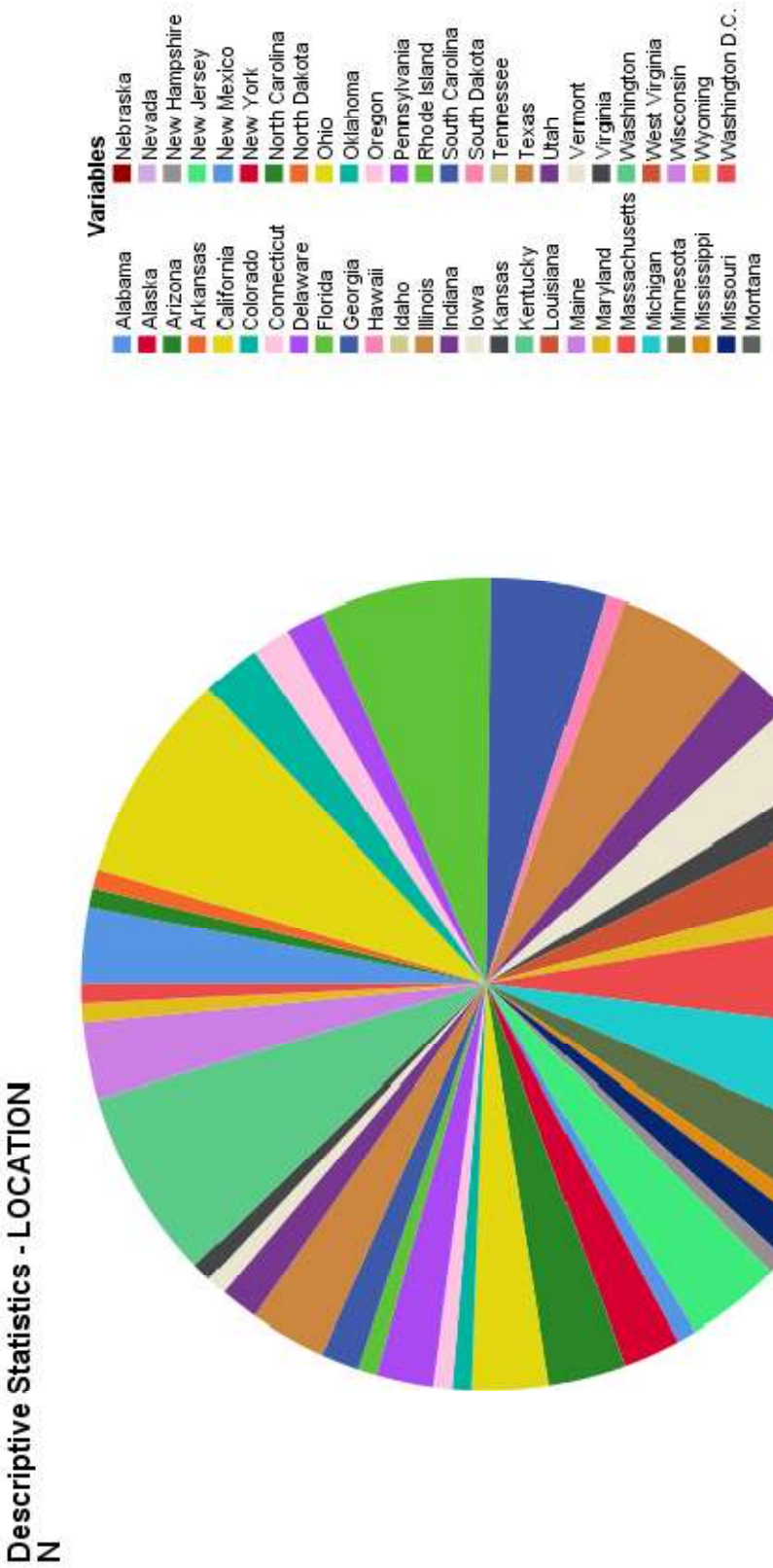


Figure 3.9 Physical location of each responding member of American Planning Association.

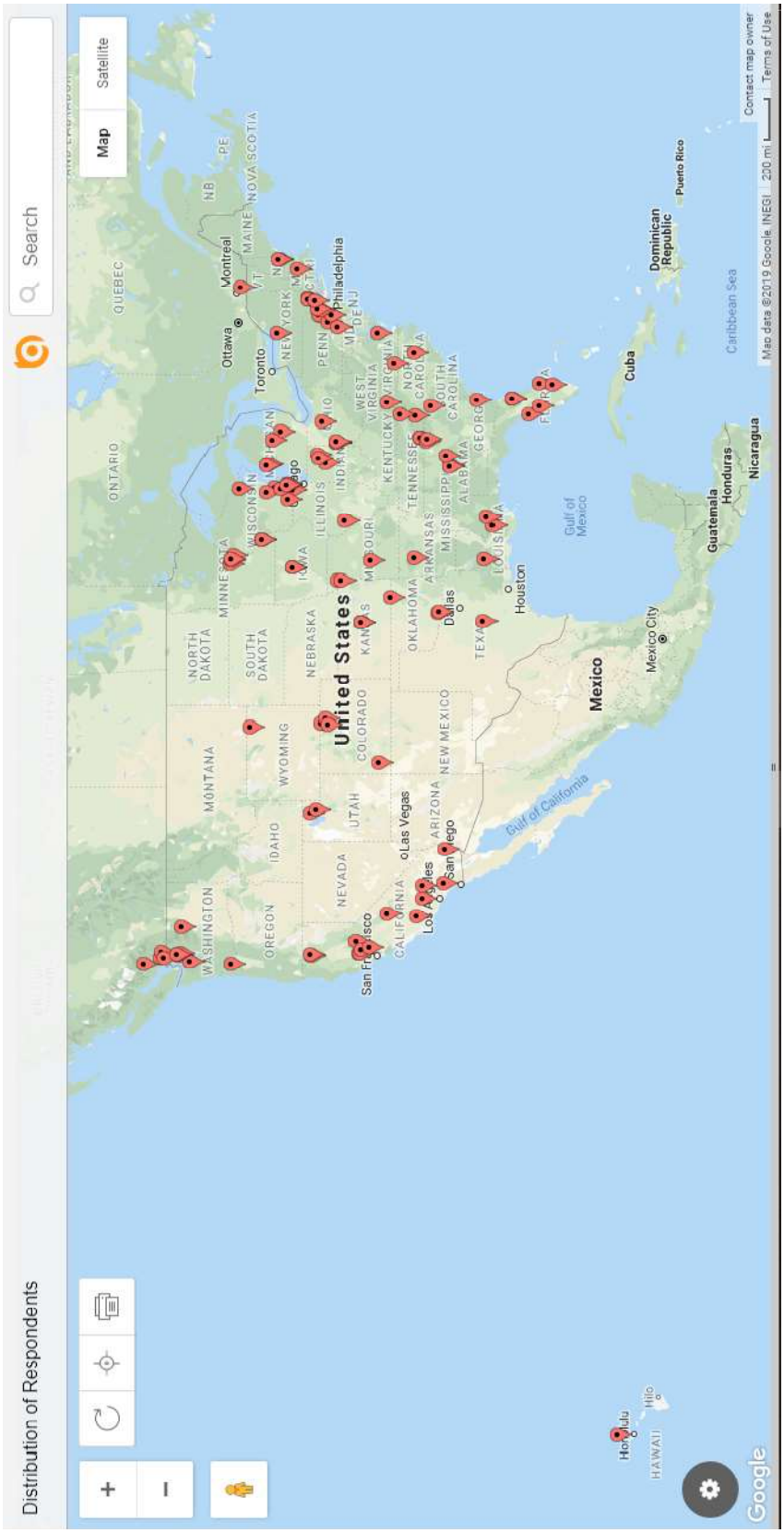


Figure 3.10 Chart displaying years working for American Planning Association participants.

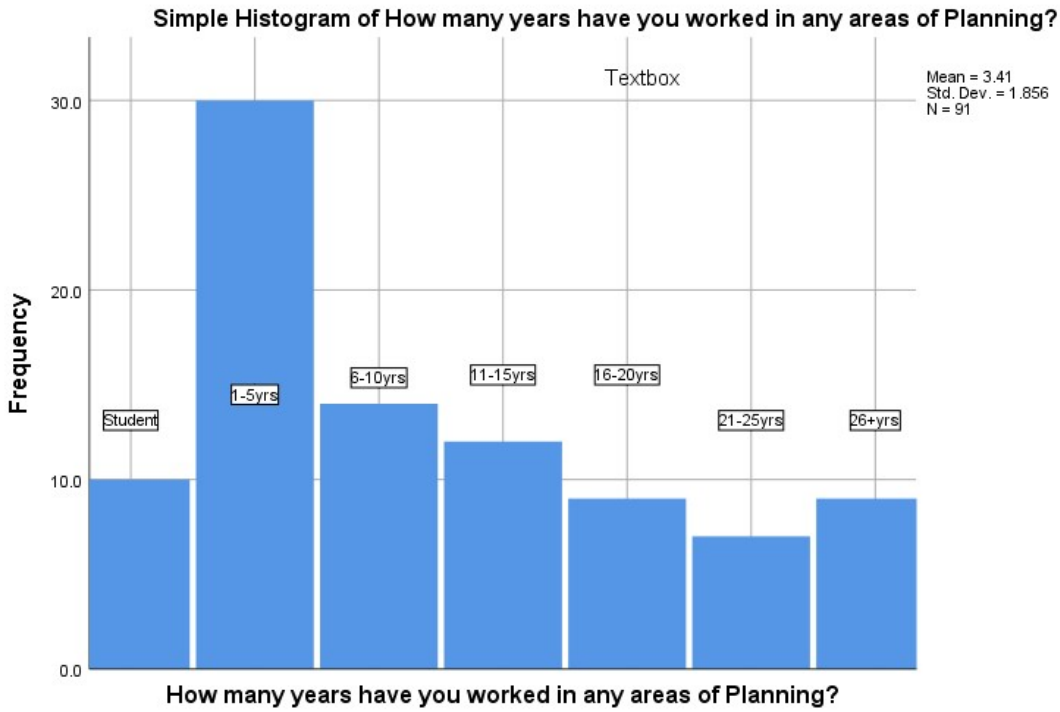


Figure 3.11 Chart displaying age ranges for American Planning Association participants.

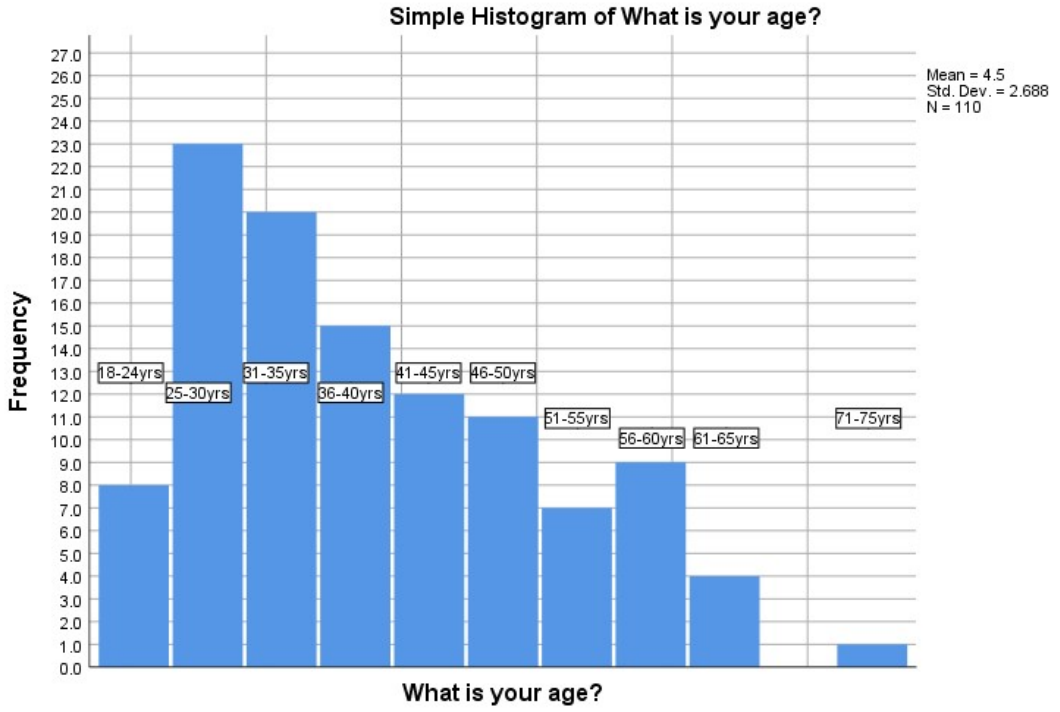


Table 3.3 American Planning Association participant's prior knowledge of rain gardens.

Prior to participating in this survey were you aware of the concept of a rain garden?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	119	90.2	94.4	94.4
	No	7	5.3	5.6	100.0
	Total	126	95.5	100.0	
Missing	System	6	4.5		
Total		132	100.0		

Table 3.4 American Planning Association participant's knowledge of their local rain gardens.

Are you aware of any rain gardens in your local community?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	88	66.7	75.2	75.2
	No	29	22.0	24.8	100.0
	Total	117	88.6	100.0	
Missing	System	15	11.4		
Total		132	100.0		

Table 3.5 American Planning Association participant's responses to whether they could think of a local rain garden after becoming aware of the concept.

Now that you are aware of the concept, can you think of a time when you may have seen one without realizing what it was called?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	3.8	71.4	71.4
	No	2	1.5	28.6	100.0
	Total	7	5.3	100.0	
Missing	System	125	94.7		
Total		132	100.0		

Table 3.6 American Planning Association participant's responses to knowledge of local rain gardens paid for with tax dollars.

Do you know of any rain gardens in your local community that have been paid for with tax dollars?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	50	37.9	43.1	43.1
	No	66	50.0	56.9	100.0
	Total	116	87.9	100.0	
Missing	System	16	12.1		
Total		132	100.0		

Table 3.7 American Planning Association participant's responses to whether they would encourage the use of a standard minimum interpretive symbol for rain gardens.

As with storm drain stamping to teach the public about the effects of dumping pollutants into them, the positive effect of interpreting these sites to the public is clear. If proven to be effective at idea transfer, would you encourage the use of an interpretive symbol for rain gardens?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	122	92.4	99.2	99.2
	No	1	.8	.8	100.0
	Total	123	93.2	100.0	
Missing	System	9	6.8		
Total		132	100.0		

*The one participant who indicated that they would not encourage the use of a standard minimum interpretive symbol reported that their reason was "cost".

Table 3.8 Descriptive statistics for responses from American Planning Association participants to rank six symbols from 1=Best, to 6=worst option for a standard minimum interpretive symbol for rain gardens.

Descriptive Statistics

	N	Sum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
-CLOUD-	116	219	1.89	.113	1.221	1.492
-CITY-	116	294	2.53	.130	1.398	1.955
-DROP-	116	364	3.14	.122	1.311	1.720
-TREE-	116	459	3.96	.094	1.016	1.033
-UMBRELLA-	116	484	4.17	.143	1.545	2.387
-LEAF-	116	616	5.31	.110	1.183	1.399
Valid N (listwise)	116					

*Following the preliminary questions 16 participants exited the survey. All data after preliminary questions have n=116.

The 116 respondents who cast their votes for ranking order were consistent in best and worst options. When selecting a top choice as #1, the lower the Sum Statistic the better the selection was ranked as most appropriate for interpreting a rain garden, i.e. a perfect score for a symbol would be (1 x 116= 116), and the worst possible score for a symbol would be (6 x 116= 696).

Importantly for the end goal was that there was evidence of consistency in the responses given by the participants as to their top and bottom three selections, as well as some insightful feedback about how to move forward with presenting a standard minimum interpretive symbol for rain gardens. Participants consistently ranked each of the six symbols such that confidence exists for the higher performing selections, as well as for any elements from lower performing symbols that should be included in the final amalgam of attributes to comprise a recommended symbol in the future. In addition to randomizing the order at which the symbols would be seen by each participant, the Qualtrics™ survey was designed to allow a positive, negative, or neutral

opinion to be registered by mouse click for each attribute, or area of interest (AOI), included in a symbol. This allowed a respondent to critique their top three ranked choices by clicking between two and four preset AOIs, as well as to write text if desired. This feature allowed for several beneficial recommendations to the designs to be registered.

Respondents reporting demographic information include one native Spanish speaker, four more indicating Spanish fluency, four with fluency in French, two fluent in German, and one Cantonese speaker. Of the 108 respondents who answered, 70 (64.8%) identified as female, 30 (34.3%) identified as male, and one selected a preference to not respond. The percentages related to education level were highest for Master's degree holders (72; 64.9%, n=111), and Bachelor's degree holders (25; 22.5%, n=111). Six (5.4%, n=111) reported possessing doctoral degrees, two (1.8%, n=111) have professional degrees, two report having college degrees, three (2.7%, n=111) have some college, and one (.9%, n=111) have a high school degree. This information was gathered to investigate correlations in responses to symbol ranking choices. Due to the low response rate this correlative analysis was not undertaken.

Figure 3.12 Overall Choice #1 of 6 by the participants from the American Planning Association for use as standard minimum interpretive symbol for rain gardens with Areas of Interest indicated.

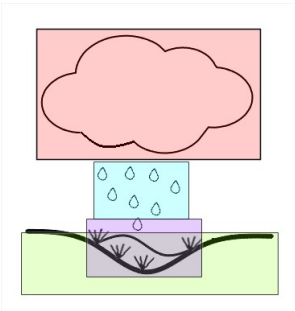


Table 3.9 Frequency of ranking choice for CLOUD symbol by participants of the American Planning Association.

-CLOUD-

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	57	49.1	49.1	49.1
	2	37	31.9	31.9	81.0
	3	10	8.6	8.6	89.7
	4	6	5.2	5.2	94.8
	5	2	1.7	1.7	96.6
	6	4	3.4	3.4	100.0
	Total	116	100.0	100.0	

Figure 3.13 Chart of ranking selection frequencies by participants of the American Planning Association.

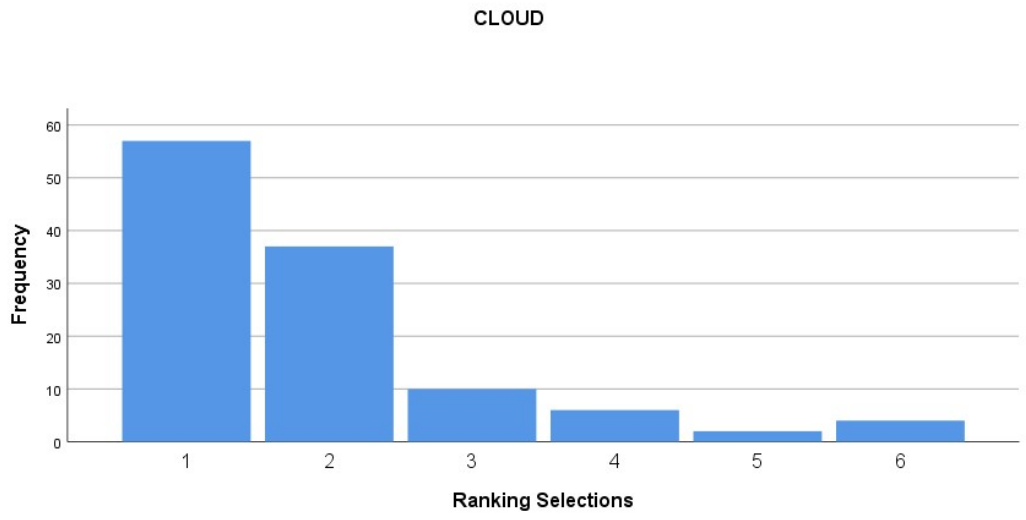


Figure 3.14 Assessment of areas of interest for CLOUD symbol by participants of the American Planning Association.

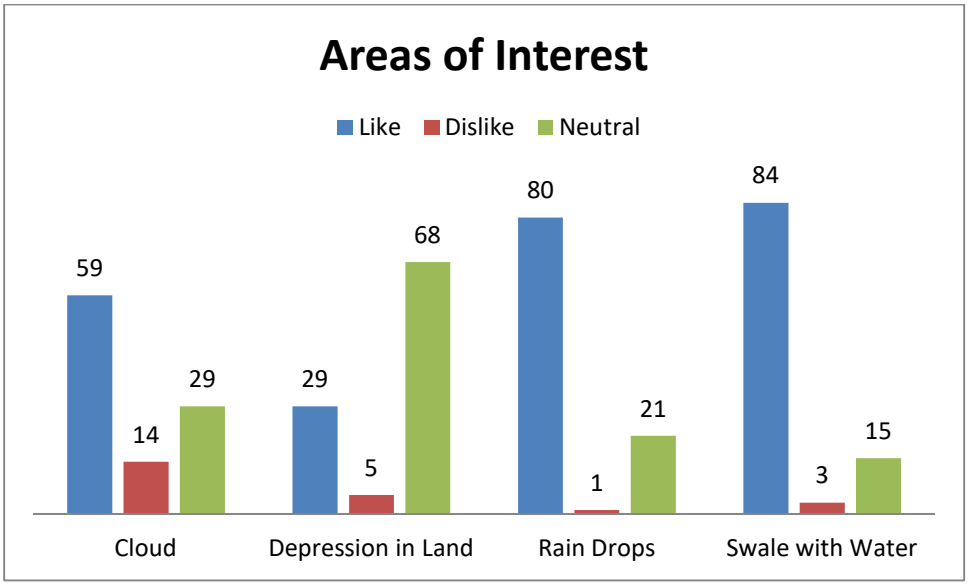


Table 3.10 Positive and negative comments from participants from the American Planning Association, grouped and counted for CLOUD symbol.

Positive Comment	Response Count	Critique	Response Count 2
clear	5	Needs Built Environment	7
balance	1	Cloud too big/ No cloud	7
simple	1	Needs Infiltration	7
		Needs Garden	4
		Rain too big	2
		Needs Drop Border	2
		Needs Flow Cycle	2
		Boring	1
		Needs Nature/ Animals	1
		Water too Curvy	1
		Too Much Space	1

Figure 3.15 Overall Choice #2 of 6 by the participants from the American Planning Association for use as standard minimum interpretive symbol for rain gardens with Areas of Interest indicated.

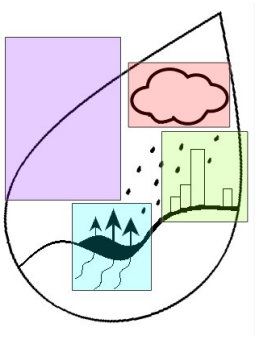


Table 3.11 Frequency of ranking choice for CITY symbol by participants of the American Planning Association.

-CITY-

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	35	30.2	30.2	30.2
	2	27	23.3	23.3	53.4
	3	27	23.3	23.3	76.7
	4	15	12.9	12.9	89.7
	5	8	6.9	6.9	96.6
	6	4	3.4	3.4	100.0
	Total	116	100.0	100.0	

Figure 3.16 Frequency of ranking choice for CITY symbol by participants of the American Planning Association.

Figure 3.17 Assessment of areas of interest for CITY symbol by participants of the American Planning Association.

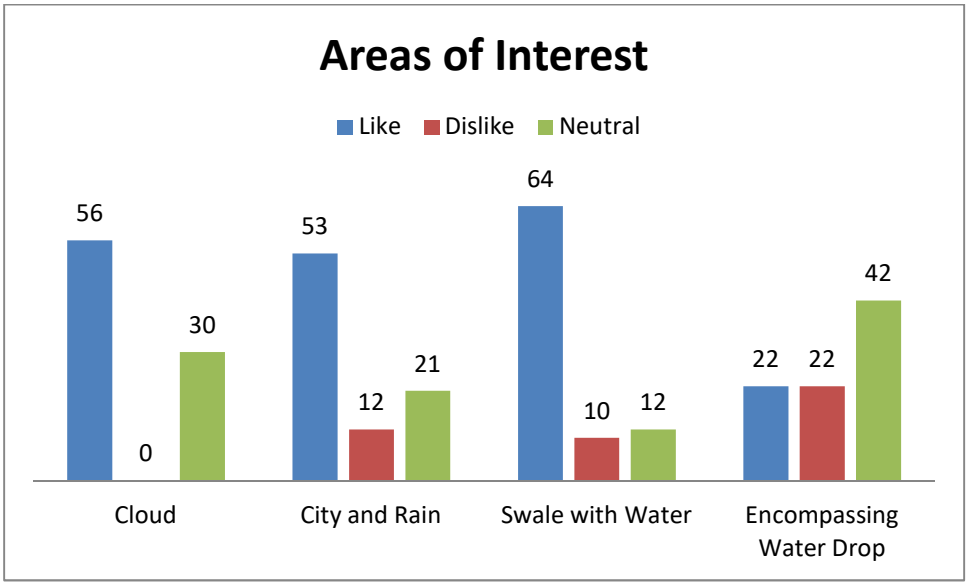


Table 3.12 Positive and negative comments from participants from the American Planning Association, grouped and counted for CITY symbol.

Positive Comment	Response Count	Critique	Response Count 2
Clear	8	Trees Confusing	10
Infiltration Clear	6	Too Urban	6
Drop Adds Style	5	Grade Confusing	4
Cycle Clear	3	Scale Off	4
Useable	1	Needs Garden	3
Urban	1	Needs Infiltration	3
		Drop Confusing	3
		Roots/ Infiltration Confusing	3
		Too Complex	1
		Needs Nature/ Animals	1
		Needs Cycle	1
		Too Abstract	1

Figure 3.18 Overall Choice #3 of 6 by the participants from the American Planning Association for use as standard minimum interpretive symbol for rain gardens with Areas of Interest indicated.

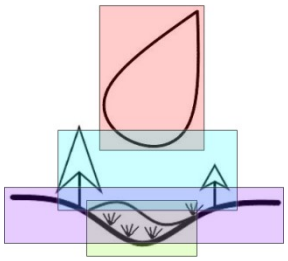


Table 3.13 Frequency of ranking choice for DROP symbol by participants of the American Planning Association.

-DROP-

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	13	11.2	11.2	11.2
	2	27	23.3	23.3	34.5
	3	30	25.9	25.9	60.3
	4	26	22.4	22.4	82.8
	5	17	14.7	14.7	97.4
	6	3	2.6	2.6	100.0
	Total	116	100.0	100.0	

Figure 3.19 Frequency of ranking choice for DROP symbol by participants of the American Planning Association.

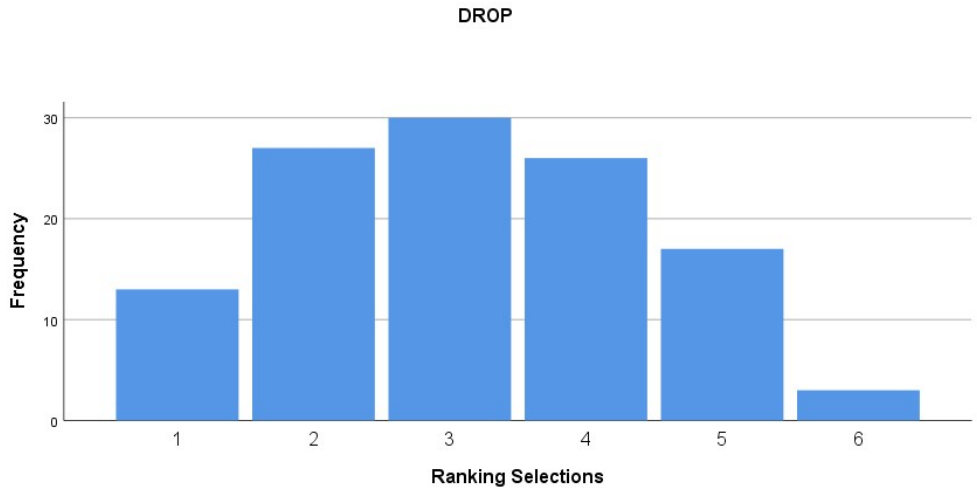


Figure 3.20 Assessment of areas of interest for DROP symbol by participants of the American Planning Association.

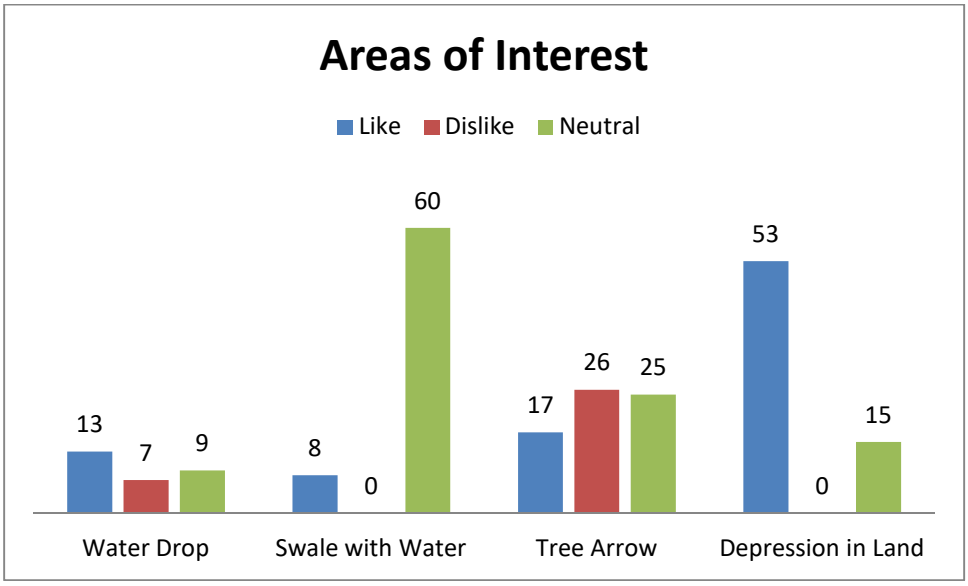


Table 3.14 Positive and negative comments from participants from the American Planning Association, grouped and counted for DROP symbol.

Positive Comment	Response Count	Critiques	Response Count 2
Tree=Arrow	2	Multiple Rain Drops	13
		Tree Arrows Confusing	11
		Needs Infiltration	3
		Needs Built Environment	2
		Too Abstract	2
		Needs Cycle	1
		Needs Nature/ Animals	1
		Needs Garden	1

Figure 3.21 Overall Choice #4 of 6 by the participants from the American Planning Association for use as standard minimum interpretive symbol for rain gardens with Areas of Interest indicated.

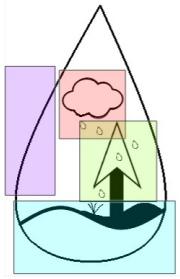


Table 3.15 Frequency of ranking choice for TREE symbol by participants of the American Planning Association.

-TREE-

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	.9	.9	.9
	2	5	4.3	4.3	5.2
	3	33	28.4	28.4	33.6
	4	44	37.9	37.9	71.6
	5	25	21.6	21.6	93.1
	6	8	6.9	6.9	100.0
	Total	116	100.0	100.0	

Figure 3.22 Frequency of ranking choice for TREE symbol by participants of the American Planning Association.

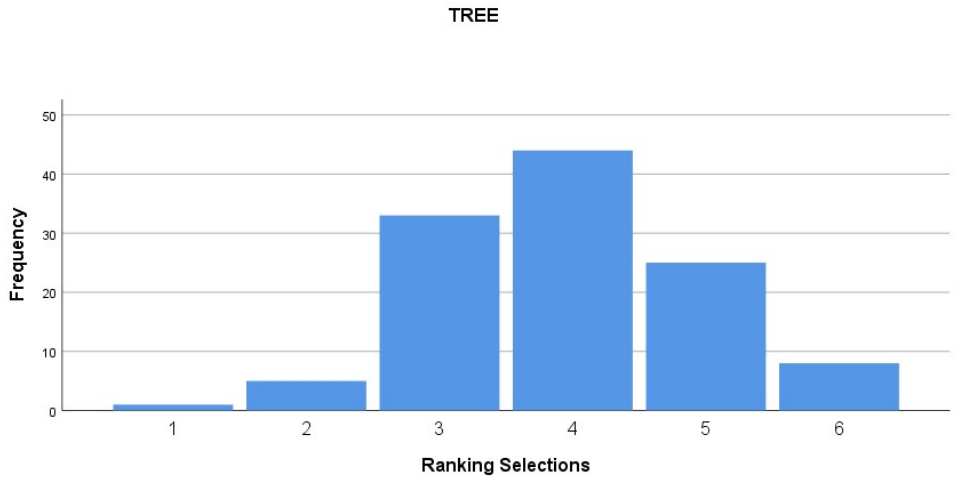


Figure 3.23 Assessment of areas of interest for TREE symbol by participants of the American Planning Association.

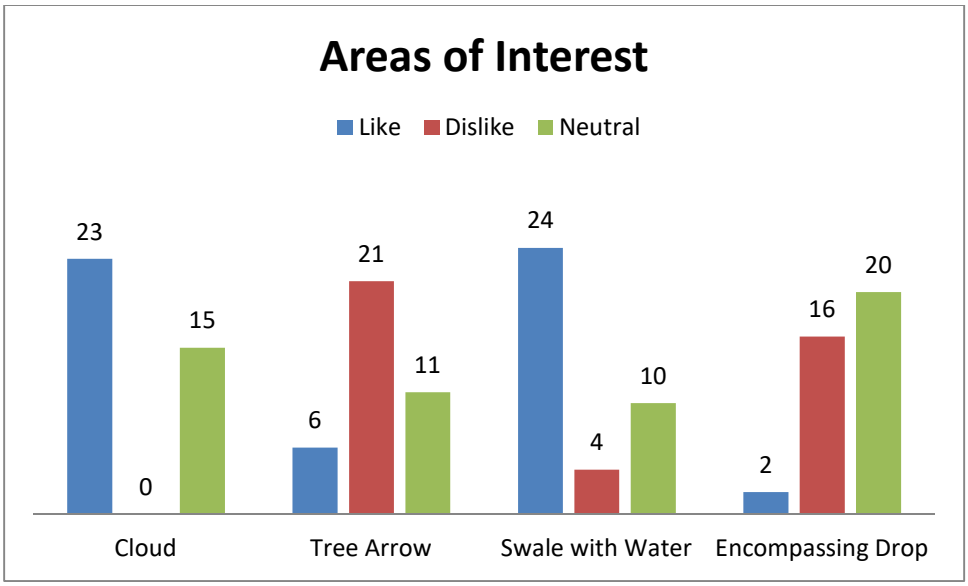


Table 3.16 Positive and negative comments from participants from the American Planning Association, grouped and counted for TREE symbol.

Positive Comment	Response Count	Critique	Response Count 2
Drop Adds Style	3	Tree Arrow Confusing	13
Tree=Arrow	1	Drop Border Not Needed	4
Planted Depression	1	Needs Garden	4
		Needs Flow/ Cycle	3
		Needs Infiltration	1
		Scale Off	1
		Too Abstract	1

Figure 3.24 Overall Choice #5 of 6 by the participants from the American Planning Association for use as standard minimum interpretive symbol for rain gardens with Areas of Interest indicated.

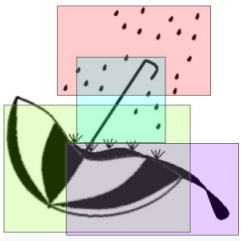


Table 3.17 Frequency of ranking choice for UMBRELLA symbol by participants of the American Planning Association.

-UMBRELLA-

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	8	6.9	6.9	6.9
	2	17	14.7	14.7	21.6
	3	8	6.9	6.9	28.4
	4	19	16.4	16.4	44.8
	5	42	36.2	36.2	81.0
	6	22	19.0	19.0	100.0
	Total	116	100.0	100.0	

Figure 3.25 Frequency of ranking choice for UMBRELLA symbol by participants of the American Planning Association.

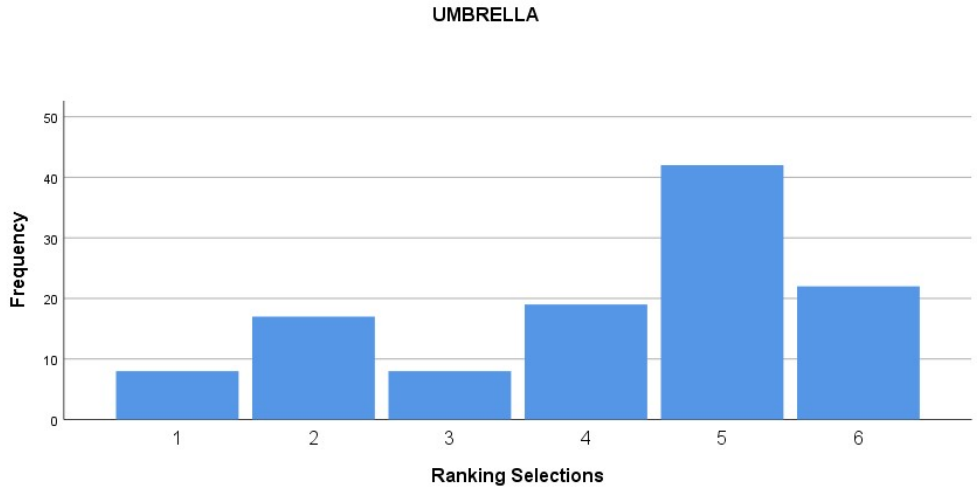


Figure 3.26 Assessment of areas of interest for UMBRELLA symbol by participants of the American Planning Association.

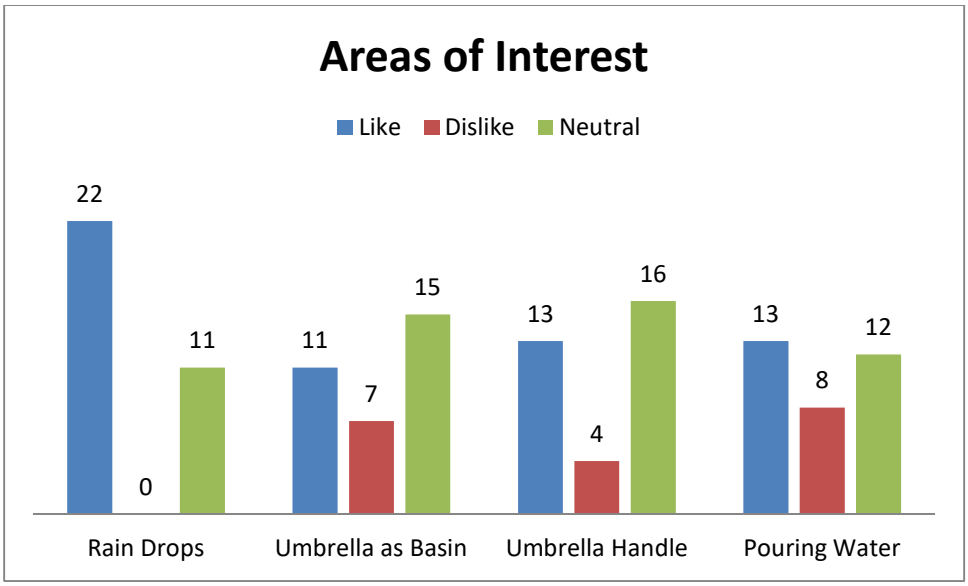


Table 3.18 Positive and negative comments from participants from the American Planning Association, grouped and counted for UMBRELLA symbol.

Positive Comment	Response Count	Critique	Response Count 2
Human	2	Needs Infiltration vs. Outflow	3
Interesting	2	Needs Garden	2
Effective	2	Confusing	1
Fresh	1		
Non-scientific	1		
Universal	1		

Figure 3.27 Overall Choice #6 of 6 by the participants from the American Planning Association for use as standard minimum interpretive symbol for rain gardens with Areas of Interest indicated.

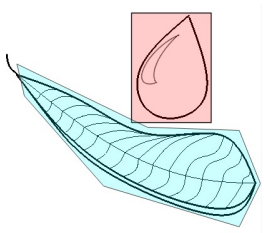


Table 3.19 Frequency of ranking choice for LEAF symbol by participants of the American Planning Association.

-LEAF-

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	2	1.7	1.7	1.7
	2	3	2.6	2.6	4.3
	3	8	6.9	6.9	11.2
	4	6	5.2	5.2	16.4
	5	22	19.0	19.0	35.3
	6	75	64.7	64.7	100.0
	Total	116	100.0	100.0	

Figure 3.28 Frequency of ranking choice for LEAF symbol by participants of the American Planning Association.

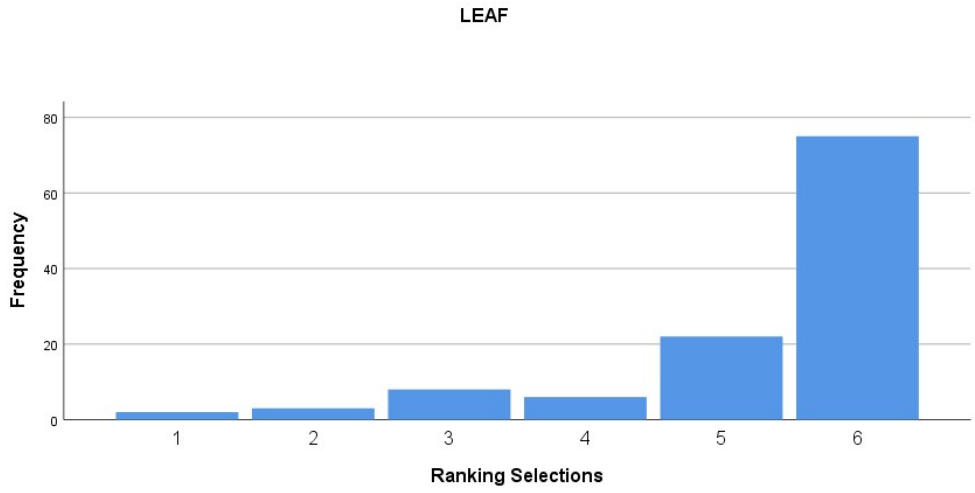


Figure 3.29 Assessment of areas of interest for LEAF symbol by participants of the American Planning Association.

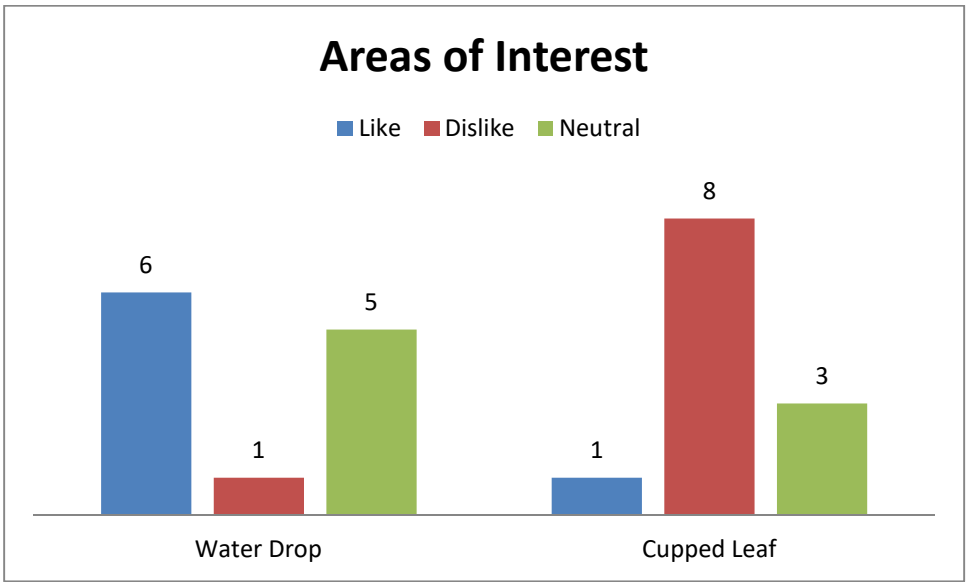


Table 3.20 Positive and negative comments from participants from the American Planning Association, grouped and counted for LEAF symbol.

Positive Comment	Response Count	Critique	Response Count 2
		Confusing	1
		Ineffective	1
		Lacking Information	1

Discussion

The response rate coupled with the high percentage of participants who reported previously knowing about the concept of a rain garden may suggest that many of our respondents had a positive bias for these ecosystem services. This can be seen as a benefit as many of the participants spent a great deal of time and consideration in completing the survey, offering critiques, and leaving notes of encouragement.

The ranking question in Qualtrics™ allowed for best and worst options to be recorded. This assured that any consensus for least good option(s) would also be revealed. This was important to the research because evidence that certain options which are seen frequently to mark a publication or association that is "green", such as the leaf with a water droplet, were not successful at interpreting all "green" things. There is a danger that overuse of certain symbols can degrade the meaning behind their adoption, as with the term "eco-friendly" (Campbell et al., 2015).

The study was designed to allow the top three choices for each participant to be critiqued both by indication of like or dislike of AOIs, and textually in open comment boxes. Because some symbols share like attributes, such as swales, clouds, rain drops, and trees, questions regarding whether similar AOIs performed consistently across the various symbols arose. Understanding that respondents do not always desire to spend time typing the survey was designed to incorporate interactive AOIs, which would allow particular critiques to be recorded more quickly, and therefore, more often.

Allowing text entry for those who were interested in expounding upon their selections and critiques lends a trove of insight into the opinions of the respondents. Many comments were

consistent for symbols, but as the frequency charts reveal, some were opposing. Only one respondent suggested that it would be necessary to start over with entirely new symbols, but the same did indicate that the CITY symbol was able to be intuited. A consistent recommendation was to alter the "tree" forms from arrow forms to rounded canopies to reduce confusion of it being an arrow indicating evaporation, only. Additionally, requests for depictions of water infiltrating soil were often left for the various symbols. Many requests were made for more depictions of plant material, as well.

Very striking to realize was that the symbol type we see in use quite often, the water droplet over a leaf, was ranked the least good option to represent rain gardens. Almost 65% (n=75) of respondents (n=116) placed it last in ranking. This suggests to us that there are better options to use in marking rain gardens.

For the two leading symbols, CLOUD and CITY, this study looked to their common attributes for insight into which elements to use moving forward in recommending a standard minimum. The CLOUD symbol includes a cloud, rain drops, basin, and moving water. The CITY symbol includes a cloud, rain drops, city buildings, basin with moving water and trees, and outlining water drop. The common elements are cloud, rain drop, and basin. Critiques of both were that the scale was off; in the case of CLOUD because the rain drops and cloud were too large; in the case of CITY because the buildings were too much like sky scrapers.

Concern was raised that the cityscape made the symbol aspect feel too large, and would not be effective in a rural or residential garden. A house, instead of a cityscape, was therefore recommended. Also in the cityscape there was confusion expressed about whether the AOI contents were trees and roots, or arrows and infiltration. Initially thinking that either interpretation would be suitable, it is now evident that better infiltration lines were a consistent

theme for both symbols. While some respondents liked the encompassing water drop outline, others found it superfluous. However, because it was an attribute included in another symbol we were able to gauge whether it was deemed a negative in both cases. In 22 cases the encompassing water drop was reported as a negative for CITY symbol, in TREE there were 16 instances of reported dislike for the same attribute. As there was less than half of the number of participants who were able to critique TREE as one of their top three choices, it cannot be said how many more participants might have indicated their support or dislike for the encompassing drop. Some recognized it as easier for eventual use in branding, but as every stamp will have natural edges or boundaries, the feeling of redundancy is understandable.

When reviewing all of the critiques, the common themes are: show infiltration, change tree canopy shape, add “herbaceous” plants, and rethink overflow/ water line.

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Chapter 4
A Rain Garden Symbol Inventory for Use in Identifying a Standard

Abstract

Others have created various symbols to represent rain garden storm water features, but no study on the trends in attributes of symbol types has been previously attempted. An inventory of 65 existing symbols was gathered through internet search. Of 22 unique element types contained within the symbols, the water drop (46%), plant form (43%), and basin (41%) were used most often, indicating a popular trend. The survey data from a companion analysis suggests two elements alone are not sufficient to describe rain gardens. This study shows that symbolizing a basin is as important to symbolizing water and plant forms. The conjunction of these three elements may be the best option for a base form of a standard minimum interpretive symbol for rain gardens.

Introduction

More than a century ago, Gertrude Jekyll, the noted British horticulturist, wrote of a "depression that collects the water from any storms of rain" (Jekyll, 1911). Whether it is called a stormwater runoff remediation site (DeBusk and Wynn, 2011), a bioretention mesocosm (Bakacs et al., 2013) , or planted depression, a well planned rain garden by any description would be as effective (Nocco et al., 2016). The science supporting the benefits of green infrastructure installations has gained traction over the last few decades (Turk et al., 2017), and the installations of these practice sites is becoming a more regular (Sun and Hall, 2016), or required (Thurston et al., 2003), feature in landscapes and constructions. Curiously, there does not seem to be a concerted effort in interpreting sites such as rain gardens in a standard, minimum way so that at a glance any of these sites may be recognizable as, at the very least, an attempt at surface water runoff remediation, sediment and nutrient capture, and an area for slow absorption of water into the ground. The published literature on the interrelated subjects of urban forestry, community planning, public perception and valuation, surface water runoff remediation, rain gardens, plant trialing, plant labeling, and consumer horticulture yield no shortage of clear excitement for the prospect of building a better world through smarter design.

Standard interpretation methods to signify the service sites as purposeful appear lacking. Major installations may display in depth interpretation in prime location sites, but these methods are not economically feasible in situations such as repeating curb cuts on city streets and parking lots, interstate on and off ramp basins, and residential installations. Moreover, certain green infrastructure installations, such as green roofs and green walls, may be self explanatory as to their purpose, where others, such as rain gardens and bioswales, are at risk of seemingly becoming overgrown litter collection areas (Erickson et al., 2010). Though they are still

functioning properly by slowing surface water flow and capturing pollutants before they reach the storm drains or natural water courses, some in the public who do not realize their function may deem such sites as derelict, messy, and purposeless; thus the importance of communication of intent is apparent (Hoyle et al., 2017c). Interpretation has the power to brand such sites as being intentionally placed (Church, 2015).

This study inventories the symbol types that are currently in use in the US and abroad. Detail rich graphics such as sketches and diagrams were not included in the symbol attribute analysis as they are not easily reproduced and would not be economically feasible to use to interpret rain gardens in repeated pattern, such as in sunken parking lot island plantings, street-side curb cuts, or common residential uses. Of interest to this study was determining trends in use of attributes seen in rain garden symbols such as basins, plant forms, water drops, and clouds. An inventory of 65 symbols used in association with rain gardens sheds light on what symbols others have adopted to interpret rain gardens to the public.

The goal in this study was to quantify the symbol types currently in use, to and determine whether there was a clear trend already quantifiable in this regard. With this information an inference can be made about what would already be leading contenders for a standard minimum interpretive symbol for rain gardens. Through contacting in the APA, the APGA, the Garden Club of America, the American Society for Horticulture Science, Auburn University, and North Carolina State University, among others, the goal is to start a movement toward using standardized interpretation for green infrastructure installations as has been done for gray infrastructure. In 1992, a group of concerned residents began to stencil storm drains in Los Angeles with a sign that read “No Dumping, This Drains to the Ocean” accented with a symbolized fish skeleton. By 2015, there were 35,000 of such interpretive symbols in that city

alone, and effects of that movement to educate the public can now be seen on storm drains across the United States (Smith, 2015). As has recently been done in New York City, NY , we see that it is time to start such an educational effort for green infrastructure (New York City Department of Environmental Protection, 2017).

Context and Methods

In reviewing governmental, municipal and societal web pages and publications related to rain gardens, awareness grew that there was inconsistency to the designs of the symbols that would accompany the text and photographs for rain gardens. In travelling to various public gardens and new constructions with an eye for stormwater runoff remediation and its interpretation, there still seemed to be no consistent symbol demarking the sites, if any symbol or interpretation was present at all. This led to the question of whether one standard interpretive symbol should be vetted and introduced. Such a symbol would need to be more than a mere hint at something "green" as so many of the options in use could be called. It would need to be more than a hint at something having to do with water, as well. It was an assumption that if a symbol could be created that could be self-explanatory and easily recreated, stamped or stenciled on rain garden sites, it would help raise awareness of the purpose of the sites it accompanied, and therefore increase the perceived value by the public.

To quantify the symbol types currently in use for rain gardens, and break down their elements to determine trends in interpretive design, each of 65 found symbols were analyzed. While some symbols could be richly detailed with multiple colors and layers of intricacy, others might be of a single color and attribute. Inventorying as many symbols that could be found on the internet was the mechanism for conducting our survey. Using Google to search for the words

“rain”, “garden”, “raingarden”, “symbol”, “sign”, “water”, “rainwater”, “storm”, and “stormwater” yielded many results. Also included were plural versions of these terms. The conjoined spelling of “raingarden” is the standard in Australia and Europe, though not as often seen used in the US.

The 22 attributes as categorized:

Iconic Drop(s)	Rain Lines	
Rain Drops	Cloud	
Umbrella	Insect	Basin
Iconic Flower(s)	Animal	Earth Line
Iconic Leaf	City/ Building	Infiltration
Plant Form(s)	Pavement/ Road	Sponge
Tree	House	Water Line/ Waves
Roots	Runoff/ Flow	(Re)Cycle- Arrow(s)

Specifically, Iconic Drop(s) could be on their own, acting as an outline for more elements, or be of large and dominant scale and have three or less replications. Rain Drops were classified by being in smaller scale, and in greater numbers, as were Rain Lines. Cloud could also be an outline for the image, or be represented as part of the image singly or as repeated billowing lines. Umbrella was any upside-down or tilted representation meant to acknowledge the opposite of the typical understood use of such. Iconic Flower(s) and Iconic Leaf could be used singly, or in groups, and could be used as an outline. Plant Forms were depictions of structured whole plants or gardens with multiple types of vegetation represented. Tree, Roots, Insect, Animal, City/ Building, Pavement/ Road, and House would be considered in any included

iteration. Runoff/ Flow would be counted separately from Water Line/ Waves as the concepts have different implications. Earth Line is any flat or mounded line used to represent ground, while Basin would be any cupped line or implied depression even if used in conjunction with Earth Line. Infiltration was counted anytime water was implied below ground level, whether by an Iconic Drop or other symbol. Sponge was counted any time the symbol made clear that the ground is porous, whether by voids in an otherwise opaque form, or etc. Finally, (Re)Cycle-Arrow(s) was counted anytime a directional arrow was used singly or in multiples.

Symbols could be from relevant logos, or graphics accompanying words, but could not be full diagrams or "artwork" that could not be easily reproduced or made into a stencil. Additionally, if a symbol, such as an Iconic Leaf, was used to mark multiple types of concepts or lines of text in the website or publication it was not counted. Elements representing insects or animals were only counted when specifically used in a cohesive amalgam to represent a landscape feature.

Results

Out of 120 returns from the internet search, the 65 that contained symbols were analyzed and their symbol attributes were categorized. The symbols found came from sources varying from government agencies to private design firms. The list of sources and their web addresses may be found in Appendix 2.

Though no symbol made use of even a third of the various element types, all used at least one. Nearly half of all of the symbols (46.15%, n=65) included, or were entirely comprised of the Iconic Drop. Just less often observed were Plant Forms (43.07%, n=65), and Basins

(41.53%, n=65). Iconic Leaf (26.15%, n=65), Earth Line (20.00%, n=65), Rain Drops (18.46%, n=65), and Water Line/ Waves (16.92%, n=65) were the only other elements to be observed more than 10 times. Rain Lines, Cloud, and Iconic Flower were each observed eight times (12.30%, n=65). Umbrella was observed six times (9.23%, n=65), and Sponge and (Re)Cycle-Arrows each were seen four times (6.15%, n=65). Animal, Pavement/ Road, and House elements were each seen twice in the symbols (3.07%, n=65). Tree, Insect, City/ Building, Runoff/ Flow, and Infiltration were each observed only once in all of the symbols (1.53%, n=65). The only element that was never seen in any of the symbols was Roots. It remains as an element category in the study because Roots often do have representation in other graphic interpretation for rain gardens, and was expected to be found in representative symbols.

Table 4.1 List of 22 elements of symbols representing rain gardens as found by internet search with observed counts and percentages in 65 symbols.

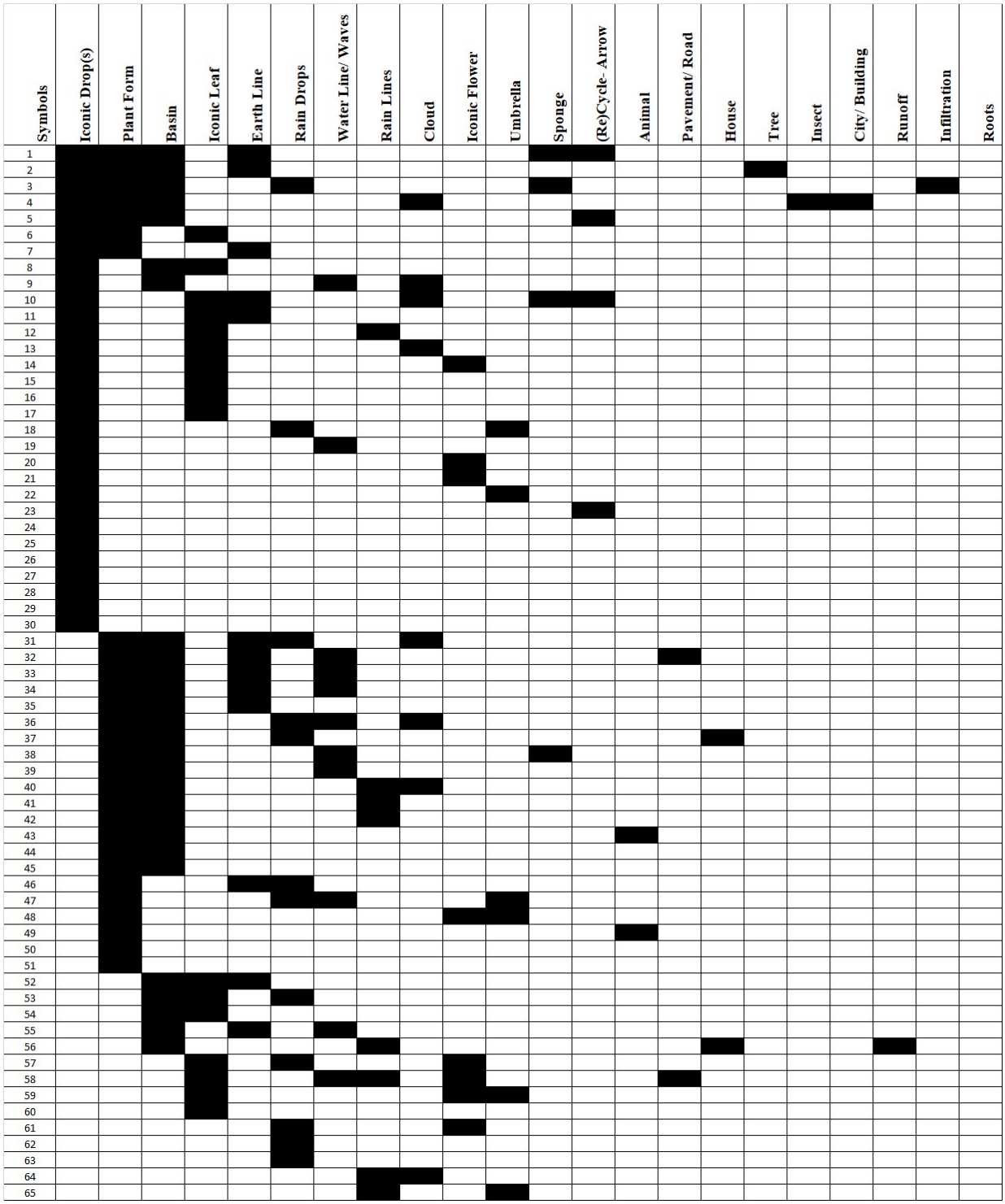
Element Observed	Observed Count	% Observed in 65 Symbols
Iconic Drop(s)	30	46.15%
Plant Form(s)	28	43.07%
Basin	27	41.53%
Iconic Leaf	17	26.15%
Earth Line	13	20.00%
Rain Drops	12	18.46%
Water Line/ Waves	11	16.92%
Rain Lines	8	12.30%
Cloud	8	12.30%
Iconic Flowers	8	12.30%
Umbrella	6	9.23%
Sponge	4	6.15%
(Re)Cycle- Arrow(s)	4	6.15%
Animal	2	3.07%
Road/ Pavement	2	3.07%
House	2	3.07%
Tree	1	1.53%
Insect	1	1.53%
City/ Building	1	1.53%
Runoff/ Flow	1	1.53%
Infiltration	1	1.53%
Roots	0	0.00%

Below is the first of two graphic representative tables of each symbol and their attributes. This table represents the occurrence of the element in solid black, and the absence of the element in white. Each column of the table represents one of the 22 categorized elements and has been arranged from most commonly seen in all 65 symbols to least, from left to right. It has further been sorted for occurrence per symbol beginning with the least common to the most common,

from right to left. In this way we can show the commonalities of symbol attributes and their combined usage.

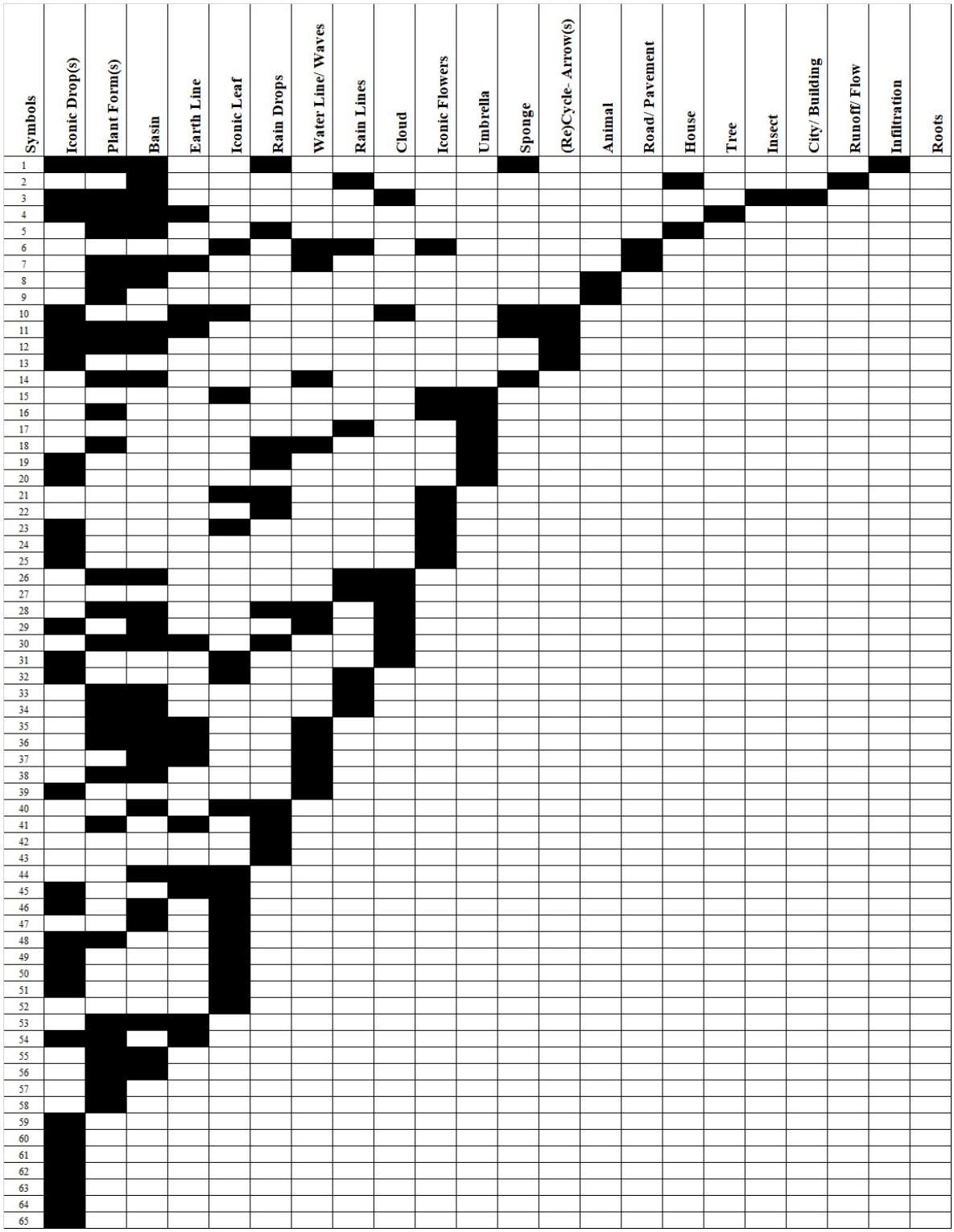
The reader can see, for example, that Iconic Drop was counted 30 times, but is part of only 23 symbols, and is used alone on seven occasions; it is never used in conjunction with Animal, Pavement/ Road, or House. The combination of Plant Form and Basin is almost as often observed as Drop, and is used with Drop on several occasions.

Table 4.2 List of rain garden symbol elements arranged from most common to least common, further sorted from least common to most common to group most common occuring elements.



Below is a different representation of the same data. The columns are arranged by most commonly observed element to least, from left to right. Unlike in the above table, this table has been sorted from left to right where the least commonly observed elements have been sorted last. This arrangement allows the reader to see more clearly the least commonly used element types. Showing the data using this arrangement allows for easier reference of uncommon attributes to show through. For example, we can quickly see that the single time Runoff was seen it was in conjunction with House, Rain Lines, and Basin.

Table 4.3 List of rain garden symbol elements arranged from most common to least common, further sorted from most common to least common to group most common occuring elements.



The sophistication levels of the symbols also vary from single element, such as the simple water drop shape representing only one attribute, to images that contain up to six attributes out of the 22 element types observed. The majority of the symbols contained three or fewer elements. Symbols containing three elements were observed 20 times (30.76%, n=65). Those that contained two elements amounted to 15 observations (23.07%, n=65), and symbols of only one element were seen on 12 occasions (18.46%, n=65). The symbols containing more elements were seen less often with four element symbols observed 9 times (13.84%, n=65), five element symbols observed five times (7.69%, n=65), and six element symbols observed 4 times (6.15%, n=65).

Table 4.4 Count of total elements used in each of 65 symbols, number and percentage of symbols utilizing each quantity.

Elements Contained in Symbol	**Number of Symbols with Element Quantity**	**Percentage of Total Symbol Count**
6	4	6.15%
5	5	7.69%
4	9	13.84%
3	20	30.76%
2	15	23.07%
1	12	18.46%
	65	**100%**

Discussion

This inventory was important to the research because it brings evidence that certain symbol options which are seen frequently used to mark a publication or association that is "green", such as the Iconic Leaf with an Iconic Drop, may not be successful enough at interpreting rain gardens without the addition of Basin. There is a danger that overuse of certain symbols can degrade the meaning behind their adoption, as with the term "eco-friendly", due to its relative brevity in the lexicon (Campbell et al., 2015).

As was anticipated, the most commonly found attribute in all of the symbols was the Iconic Drop representing water, followed closely by Plant Forms. This stands to reason as most casual observers would recognize each for their inherent meaning. The third most common element was the Basin, which is a necessary part of any rain garden and therefore makes sense to see in its representation or close association. It is noteworthy that it was not the most prevalent attribute given its place in every rain garden; however, if the shape of the Umbrella is considered as Basin, then it would have been the most prevalent. Because symbols that use Umbrella are specifically different than generic cupped lines, they were not counted as Basins for the purposes of this study.

The table grouping the lesser used elements is suggestive of which elements are not as useful in determining what to include within a standard minimum interpretive symbol. Half of the table is empty, which may indicate that half of the element types should not ever be in consideration for a standard. If nearly half of all symbols utilize the Iconic Drop, Plant Form, and/ or Basin, the public seems to be indicating a preference for what iconography is preferred to use for representing rain gardens.

The symbol adopted by New York City, NY, to represent and accompany municipal rain gardens was also noteworthy in that it was one of only two symbols to use Pavement/ Road. New York City's rain garden symbol is bisected by a Roadway and uses Rain Lines above, Water Lines/ Waves below, and Iconic Flower and Iconic Leaf in conjunction. That the New York City Department of Environmental Protection is branding green infrastructure sites is encouraging for this research. A large city with a generous budget may be able to afford to have such "pucks" accompany their rain gardens, but for cities, businesses, and homeowners who cannot, the need for an easily reproduced and stenciled design option exists, and should be available.

Because rain gardens are not wetlands or ponds, a caution on the use of the Iconic Drop as a main factor to use in its representation is recommended. The Iconic Drop is also used extensively by others not representing rain gardens specifically. Whether by departments of water resources, plumbing companies, or on water bottles, each time it is used other than for rain gardens can confuse the meaning intended when using it in a symbol for rain gardens. The data shows that the combination of Plant Form and Basin are nearly equal in their occurrence with that of Iconic Drop. Because a Basin is an inherent aspect of any rain garden, using it in the symbol works to set it apart from other landscape types.

The data also shows that symbols containing three elements have been more predominantly used; therefore it may be that the best option is a three element symbol that in some way incorporates the Plant Form, Basin, and Iconic Drop. However, the data show that such a combination was observed only five times out of 65, and never just the three elements alone. The closest to such a symbol included the element of cycling arrows to bring to mind the idea of the water cycle. This symbol was created for the 700milliongallons.org website, which

represents the goal of Seattle, Washington, to capture 700 million gallons of water a year through green stormwater infrastructure. They employ a very simple symbol to represent this type of site on their webpage and do not encumber it through over-embellishment. Such a symbol can be used in cities, towns, public gardens, rural areas, and at residences. It can be quickly replicated and adapted to meet the design preference of any user. It can also be made into a stencil and used to mark rain gardens at little cost.

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Recommendations for Future Research

Future researchers could build upon these studies in several ways. A selection, or selections, of suggested rain garden symbol amalgams could be used in valuation studies using eye-tracking technology. Using eye-tracking technology of gaze analysis an experiment could be conducted whereby participants are shown a photograph of a rain garden of low sophistication where some would see the proposed symbol accompanying the image, some would see the same rain garden image with the words "rain garden", and some would see the image alone. Asking the participants to rate their opinion of the image could yield interesting results related to the efficacy of the symbol. Analyzing AOI, gaze duration, time to first fixation, and repeated attention to the symbol might reveal more information about its effect on the concentration paid certain areas of the rain garden depicted by the symbol.

Another experiment could reveal the effect the symbol has on children. Selecting schools that have installed rain gardens, or will be installing rain gardens, would allow a before and after comparison to the effect of the symbol. Because the ultimate goal is to raise awareness and valuation by the public, the earlier we can reach populations the more effect adopting a standard symbol should have in the future. The connection of children to cartoon images suggests that versions of the symbol could be adapted for younger eyes. These might utilize softer lines, or even make the symbol into a personified entity, and tested with valuation change for younger audiences.

With regard to increasing the use of the symbol for rain gardens, a survey sent to all rain garden advocacy groups, authorities, and installers can increase the power of this project. University and college campuses could also be contacted to raise awareness of the project. The

EPA may also be reached and persuaded to adopt the use of the standard as they currently have a webpage for rain gardens, but no symbol or graphic displayed as representation.

The New York City Department of Environmental Protection has already adopted stamp designs for green infrastructure in general, and specifically for rain gardens, green roofs, permeable pavement, and synthetic turf. This adoption of simple interpretation for green infrastructure, debuted on the cover of the NYC Department of Environmental Protection Annual Report for 2017, is encouraging for this research. These brands are being used on door hangers with interpretation of the green infrastructure installations scheduled to be installed on their streets, as well as the benefits that each will bring to the resident. This is in an effort to raise public awareness and valuation. A future study could survey the residents who received the door hangers and compare their responses to those from nearby residents who have not been informed about the benefits of rain gardens.

The American Public Garden Association could be involved in this research. As progenitors of progress in their field, their member gardens have millions of annual visitors that could assist with the expedited adoption of a standard minimum interpretive symbol for rain gardens. Many will already have rain gardens installed, so an introduction of a standard symbol within those gardens might be welcomed.

Finally, a survey with requests for adoption could be sent to the Boy and Girl Scouts of America to solicit their help in applying stamps to curb cuts, etc., in their local communities. With associations for positive environmental change solicited for help, it may be that a measurable volume of change toward adopting the use of a standard minimum interpretive symbol for rain gardens can be attainable.

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Appendix 1
Qualtrics Survey

APA Member Survey: Most Interpretive Symbol

Survey Flow

Block: Introduction and Consent (11 Questions)
Standard: Introduction of Symbols (1 Question)
Standard: Randomized Symbols (6 Questions)
Standard: Ranking block (25 Questions)
Standard: Demographics block (15 Questions)
Standard: Closing block (1 Question)

EndSurvey:

Start of Block: Introduction and Consent

This is a survey designed to allow you, the diverse people with interests in the field of planning, to help us identify a standard minimum, but most self-explanatory, symbol to use to interpret rain gardens to the public with the goal of raising the value that members of the public would attribute to such a site.

Whether you have heard of rain gardens, or not, we hope you will participate and let us know your opinions.

This Qualtrics survey will let you rank and critique six symbols that represent image types already in use. Estimated time to completion is 10-15 minutes.

This survey was designed as part of a master's research project by Keith Lukowski in the department of Horticulture at Auburn University in Alabama. He may be reached at kzl0058@auburn.edu.

Questions may also be directed to his faculty adviser, Dr. Carolyn W. Robinson at cwr0001@auburn.edu.

The final results will be available to participants upon request to Dr. Robinson.
No identifiable information will be collected or stored.
There are no costs or associated benefits to completing this survey.
There are no risks or discomforts foreseen in participating in this survey.
Participation in the survey is on a voluntary basis, and you may exit the survey at any point.
If you have any questions you may contact the Auburn University Institutional Review Board (IRB) at irbadmin@auburn.edu, or at (334) 844-5966.

By clicking the arrow below you are entering the survey.

Thank you for participating in our survey!

In case you were not aware, a rain garden is a planted or free-growing depression in the landscape that is designed and sited to capture the first one to two inches of water runoff from a given area.

Unlike in a retention pond, the water captured infiltrates into the soil, is taken up by plants, or evaporates within two days to prevent mosquito breeding.

These landscape service sites are effective at slowing surface water flow, which allows water to cool and be filtered of pollutants of various types before reaching storm drains.

While large installations in prominent locations may have detailed interpretation on site, we are interested in finding a simple symbol that can be stamped, stenciled, or easily redrawn so that anyone may add interpretation at a low cost.

We have made six symbols which are combinations of the various types currently in use in the U.S. and abroad, and this study will help us understand which are more effective at idea transfer to a diverse population.

Properly designed and installed rain gardens are proven to be effective at slowing, cooling, and cleaning the water they capture.

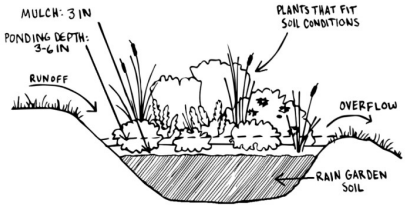
Across the country, and the world, these installations are becoming a more regular landscape feature.

In fact, a study out of the U.K. in 2015 found that when considering future regret in the year 2050 for present day decisions regarding gray versus green systems for storm water infrastructure, of all the scenarios considered, the use of residential rain gardens were found to result in the least amount of future regret.

There is a growing trend toward the use of a variety of green infrastructure types, in conjunction with gray.

We see a need to adopt standard minimum interpretive symbols that represent the various green infrastructure types in an effort to raise awareness and perceived value by the public.

Graphic of the basic form and function of a small rain garden.
*Image credit: Claire Krofft, Auburn University



Prior to participating in this survey were you aware of the concept of a rain garden?

- Yes (1)
- No (2)

Display This Question:

If Prior to participating in this survey were you aware of the concept of a rain garden? = Yes

Are you aware of any rain gardens in your local community?

- Yes (1)
- No (2)

Display This Question:

If Prior to participating in this survey were you aware of the concept of a rain garden? = No

Now that you are aware of the concept, can you think of a time when you may have seen one without realizing what it was called?

- Yes (1)
- No (2)

Display This Question:

If Prior to participating in this survey were you aware of the concept of a rain garden? = Yes

Do you know of any rain gardens in your local community that have been paid for with tax dollars?

- Yes (1)
- No (2)

As with storm drain stamping to teach the public about the effects of dumping pollutants into them, the positive effect of interpreting these sites to the public is clear.

If proven to be effective at idea transfer, would you encourage the use of an interpretive symbol for rain gardens?

- Yes (1)

○ No (2)

Display This Question:

If As with storm drain stamping to teach the public about the effects of dumping pollutants into the... = No

Please tell us what might keep you from encouraging the use of an interpretive symbol for rain gardens.

_____

State-wide averages for rain and snow fall range from 9.5 inches in Nevada to 63.7 inches in Hawaii.

Whether the need is to conserve the little that falls, or have a plan for the abundance, rain gardens can help in many situations.

Do you know the average annual rainfall in your community?

Use the slide bar below to indicate what you would estimate is the average amount of precipitation in your local community.

0 10 20 30 40 50 60 70 80 90 100

Average annual precipitation in inches (1)	

End of Block: Introduction and Consent

Start of Block: Introduction of Symbols

In the following section are six images that attempt to represent the form and function of a rain garden and are based on general image types already in use.

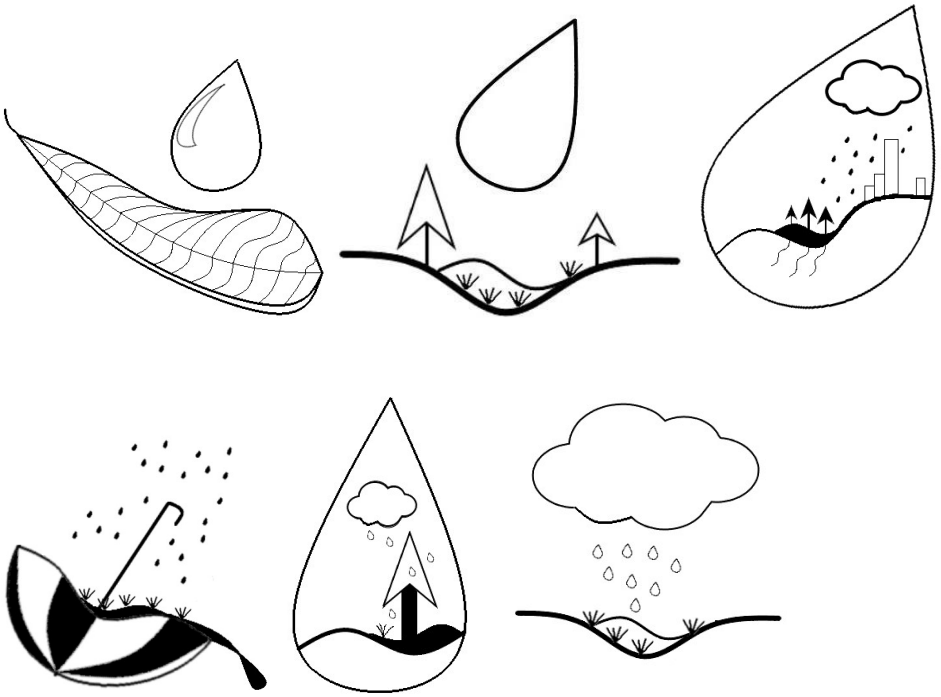
They are not an attempt at making fine art.

We are interested in your opinions about which are more self-explanatory.

Please look through the six, then you will have the opportunity to rank and critique your top three selections.

End of Block: Introduction of Symbols

Start of Block: Randomized Symbols



End of Block: Randomized Symbols

Start of Block: Ranking block

Please rank the six symbols from 1-6 with one being your first choice and six being your last choice for an effective interpretive symbol.

For this research project, we are as interested in the what you consider to be the least effective symbols as well as the most effective.

Following this ranking section you will have the opportunity to critique your top three choices.

_____ Image:Big rain drop sq (1)

_____ Image:Cloud sq (2)

_____ Image:Umbrella sq (3)

_____ Image:Water drop over leaf sq (4)

_____ Image:Water drop with up arrow tree in basin sq (5)

_____ Image:Water drop, city, basin, water flow, cloud, rain sq (6)

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Big rain drop sq] = 1

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Big rain drop sq] = 2

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Big rain drop sq] = 3

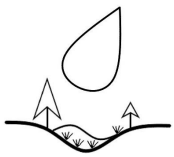
Display This Question:

Scroll over the image to see regions of interest.

Click once on the regions of the image that you think are effective at depicting the function of a rain garden.

Double-click on areas that you think are not effective.

	Dislike (1)	Neutral (2)	Like (3)
Water Drop (8)			
Swale with water (9)			
Tree Arrows (10)			
Depression in land (11)			



If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Big rain drop sq] < 4

Comments or suggestions?

_____

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Cloud sq] = 1

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Cloud sq] = 2

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Cloud sq] = 3

Scroll over the image to see regions of interest.

Click once on the regions of the image that you think are effective at depicting the function of a rain garden.

Double-click on areas that you think are not effective.

	Dislike (1)	Neutral (2)	Like (3)
Cloud (8)			
Depression in land (9)			
Rain drops (10)			
Swale with water (12)			

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Cloud sq] < 4

Comments or suggestions?

_____

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Umbrella sq] = 1

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Umbrella sq] = 2

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Umbrella sq] = 3

Scroll over the image to see regions of interest.

Click once on the regions of the image that you think are effective at depicting the function of a rain garden.

Double-click on areas that you think are not effective.

	Dislike (1)	Neutral (2)	Like (3)
Rain drops (8)			
Umbrella as basin (9)			
Umbrella handle (10)			
Pouring out of basin (12)			

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Umbrella sq] < 4

Comments or suggestions?

_____

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop over leaf sq] = 1

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop over leaf sq] = 2

Display This Question:

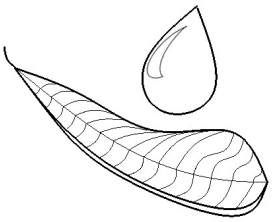
If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop over leaf sq] = 3

Scroll over the image to see regions of interest.

Click once on the regions of the image that you think are effective at depicting the function of a rain garden.

Double-click on areas that you think are not effective.

	Dislike (1)	Neutral (2)	Like (3)
Water drop (8)			
Cupped Leaf (9)			



Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop over leaf sq] < 4

Comments or suggestions?

_____

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop with up arrow tree in basin sq] = 1

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop with up arrow tree in basin sq] = 2

Display This Question:

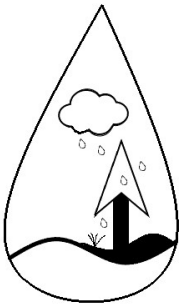
If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop with up arrow tree in basin sq] = 3

Scroll over the image to see regions of interest.

Click once on the regions of the image that you think are effective at depicting the function of a rain garden.

Double-click on areas that you think are not effective.

	Dislike (1)	Neutral (2)	Like (3)
Cloud (8)			
Arrow tree (9)			
Swale with water (13)			
Encompassing drop (14)			



Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop with up arrow tree in basin sq] < 4

Comments or suggestions?

_____

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop, city, basin, water flow, cloud, rain sq] = 1

Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop, city, basin, water flow, cloud, rain sq] = 2

Display This Question:

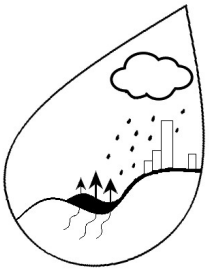
If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop, city, basin, water flow, cloud, rain sq] = 3

Scroll over the image to see regions of interest.

Click once on the regions of the image that you think are effective at depicting the function of a rain garden.

Double-click on areas that you think are not effective.

	Dislike (1)	Neutral (2)	Like (3)
Cloud (8)			
City scape and rain (9)			
Swale with water (13)			
Encompassing water drop (14)			



Display This Question:

If Please rank the six symbols from 1-6 with one being your first choice and six being your last cho... [Image:Water drop, city, basin, water flow, cloud, rain sq] < 4

Comments or suggestions?

_____

End of Block: Ranking block

Start of Block: Demographics block

Thank you for your input. This section is designed to reveal any trends in selections based on demographics and your place in the field of planning.

Please note that your responses will be kept confidential and data will only be used in aggregate.

Please select any or all of the categories that apply to you.

- ☐ I work in the Private Sector (1)
- ☐ I work in the Public Sector (2)
- ☐ I am an Educator/ Researcher (3)
- ☐ I work for Non-Profit organizations (4)
- ☐ I am a Student (5)
- ☐ I am Retired (6)

Select any or all of the specializations that best fits your interests in planning.

*Selecting "Prefer to Self Describe" will give you that option in the next section.

- [ ] Community Activism/ Empowerment (1)
- [ ] Community Development (2)
- [ ] Comprehensive/ Long-Range Planning (3)
- [ ] Economic Development (4)
- [ ] Education (16)
- [ ] Environmental/ Natural Resources Planning (5)
- [ ] Food Systems Planning (6)
- [ ] Hazard Mitigation/ Disaster Recovery Planning (7)
- [ ] Historic Preservation (8)
- [ ] Housing (9)
- [ ] Landscape Architecture (19)
- [ ] Land Use and Code Enforcement (10)
- [ ] Planning Law (15)
- [ ] Parks & Recreation (11)
- [ ] Planning Management/ Finance (12)
- [ ] Transportation Planning (13)
- [ ] Urban Design (14)
- [ ] Prefer to Self Describe (17)

Display This Question:

*If Select any or all of the specializations that best fits your interests in planning. *Selecting "P... = Prefer to Self Describe*

Please tell us your areas of interest.

_____

How many years have you worked in any areas of Planning?

▼ Student/ Recent Graduate (1) ... 26+ years (7)

In what State(s) do you currently work/ study/ live?

- [ ] Alabama (1)
- [ ] Alaska (2)
- [ ] Arizona (3)
- [ ] Arkansas (4)
- [ ] California (5)
- [ ] Colorado (6)
- [ ] Connecticut (7)
- [ ] Delaware (8)
- [ ] Florida (9)
- [ ] Georgia (10)
- [ ] Hawaii (11)
- [ ] Idaho (12)
- [ ] Illinois (13)
- [ ] Indiana (14)
- [ ] Iowa (15)
- [ ] Kansas (16)
- [ ] Kentucky (17)
- [ ] Louisiana (18)
- [ ] Maine (19)
- [ ] Maryland (20)
- [ ] Massachusetts (21)
- [ ] Michigan (22)
- [ ] Minnesota (23)
- [ ] Mississippi (24)
- [ ] Missouri (25)
- [ ] Montana (26)
- [ ] Nebraska (27)
- [ ] Nevada (28)
- [ ] New Hampshire (29)
- [ ] New Jersey (30)
- [ ] New Mexico (31)
- [ ] New York (32)
- [ ] North Carolina (33)
- [ ] North Dakota (34)
- [ ] Ohio (35)
- [ ] Oklahoma (36)
- [ ] Oregon (37)
- [ ] Pennsylvania (38)
- [ ] Rhode Island (39)
- [ ] South Carolina (40)
- [ ] South Dakota (41)
- [ ] Tennessee (42)
- [ ] Texas (43)
- [ ] Utah (44)
- [ ] Vermont (45)
- [ ] Virginia (46)
- [ ] Washington (47)
- [ ] West Virginia (48)
- [ ] Wisconsin (49)
- [ ] Wyoming (50)
- [ ] Washington D.C. (51)

If you work/ study/ live outside of the U.S. please list the countries or territories.

_____

What is your age?

▼ 18-24 (1) ... Prefer not to respond (12)

How do you identify yourself?

▼ Female (1) ... Prefer not to answer (5)

How do you identify yourself?
Please check all that apply.

- ☐ African (4)
- ☐ American Indian or Alaska Native (1)
- ☐ Asian (2)
- ☐ Arabian (11)
- ☐ Black or African American (3)
- ☐ Latino/ Hispanic (5)
- ☐ Native Hawaiian or Other Pacific Islander (6)
- ☐ White (7)
- ☐ Unknown (8)
- ☐ Other/ Prefer to self-describe (9)
- ☐ Prefer not to answer (10)

Display This Question:

If How do you identify yourself? Please check all that apply. = Other/ Prefer to self-describe

You indicated that you would prefer to self describe. Please tell us how you identify.

_____

What is the highest education level you have completed?

▼ High school diploma (1) ... Other/ Prefer not to answer (9)

Is English your native language?

- ○ Yes (1)
- ○ No (2)
- ○ Prefer not to answer (3)

Display This Question:

If Is English your native language? = No

What is your native language?

_____

Please tell us any other languages in which you are fluent.

_____

End of Block: Demographics block

Start of Block: Closing block

If there is anything you wish to add to your responses please feel free to comment below.

To reach the corresponding researcher directly, email Dr. Carolyn W. Robinson at cwr0001@auburn.edu.

Click the arrow to exit the survey.

Thank you for your time!

Appendix 2
Permission Letter from American Planning Association

American Planning Association

Creating Great Communities for All

June 7, 2019

Auburn University Institutional Review Board
c/o Office of Research Compliance
115 Ramsay Hall
Auburn, AL 36849

Please note that Mr. Keith Lukowski, AU Graduate Student, has the permission of the American Planning Association (APA) to conduct research with our membership for his study, "Identifying a Standard Minimum Interpretive Symbol for Rain Gardens to Raise Public Awareness and Valuation."

Mr. Lukowski has sent us a link to preview his Qualtirics survey, as well as a PDF that contains the display and skip logic programmed within the survey structure. APA will embed a link to his survey at the end of one of our biweekly newsletters, APA Interact, which goes out to all members. Members who voluntarily open our emailed newsletter and proceed to click on the link into the survey will have self-selected to participate. This is the extent to which our members will be recruited. Once a member has clicked to follow the link, the survey's opening page will consent the participant. APA will only put this link in one newsletter. We understand that Mr. Lukowski will accept responses for one month before closing the survey.

Mr. Lukowski will never be in direct contact with any of our members regarding their participation. Mr. Lukowski has also agreed to provide to APA any of the aggregate data he collects through this survey. Additionally, he is willing to share his results following statistical analysis.

If there are any questions, please contact me.

Signed,

David Morley, AICP
American Planning Association
Research Program and QA Manager
312.786.6392 | dmorley@planning.org

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APA President
Kurt E. Christiansen, AICP

Chief Executive Officer
Joel Albizo, hon. AIA

planning.org

Appendix 3
Internal Review Board Permission

Auburn University Human Research Protection Program

EXEMPTION REVIEW APPLICATION

For information or help completing this form, contact: **THE OFFICE OF RESEARCH COMPLIANCE,**
Location: 115 Ramsay Hall **Phone:** 334-844-5966 **Email:** IRBAdmin@auburn.edu

Submit completed application and supporting material as one attachment to IRBsubmit@auburn.edu.

1. PROJECT IDENTIFICATION **Date** 6/10/2019

a. Project Title Identifying a Standard Minimum Interpretive Symbol for Rain Gardens to Raise Public Awareness and Valuation

b. Principal Investigator Keith Lukowski Degree(s) Master of Science
Rank/Title _____ Department/School Horticulture
Phone Number 919-434-4189 AU Email kzl0058@auburn.edu

Faculty Principal Investigator (required if PI is a student) Carolyn Robinson
Title Doctor Department/School Horticulture
Phone Number 334-844-3031 AU Email cwr0001@auburn.edu

Dept Head Dr. Desmond Layne Department/School Horticulture
Phone Number 334-844-4906 AU Email dll0021@auburn.edu

c. Project Personnel (other PI) – Identify all individuals who will be involved with the conduct of the research and include their role on the project. Role may include design, recruitment, consent process, data collection, data analysis, and reporting. Attach a table if needed for additional personnel.

Personnel Name _____ Degree (s) _____
Rank/Title _____ Department/School _____
Role _____
AU affiliated? ☐ YES ☐ NO If no, name of home institution _____
Plan for IRB approval for non-AU affiliated personnel? _____

Personnel Name _____ Degree (s) _____
Rank/Title _____ Department/School _____
Role _____
AU affiliated? ☐ YES ☐ NO If no, name of home institution _____
Plan for IRB approval for non-AU affiliated personnel? _____

Personnel Name _____ Degree (s) _____
Rank/Title _____ Department/School _____
Role _____
AU affiliated? ☐ YES ☐ NO If no, name of home institution _____
Plan for IRB approval for non-AU affiliated personnel? _____

d. Training – Have all Key Personnel completed CITI human subjects training (including elective modules related to this research) within the last 3 years? YES ■ NO ☐

The Auburn University Institutional Review Board has approved this Document for use from 07/3/2019 to ----------
Protocol # 19-269 EX 1907

Appendix 4
Inventory of Rain Garden Symbols with Web Addresses

Ref. #	Organization / Publication	Origin
1	12,000 Rain Gardens in Puget Sound	US
2	University of Connecticut	US
3	UCONN Rain Garden App	US
4	Three Rivers Rain Garden Alliance	US
5	Environmental Protection Agency Soak up the Rain- Rain Garden Poster	US
6	Rain Garden Network	US
7	UK Rain Garden Guide	UK
8	700milliongallons.org Rain Garden Infosheet	US
9	Washtenaw County, MI Rain Garden Website	US
10	Rutgers University Extension Rain Garden Brochure	US
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12	Virginia Department of Forestry Rain Garden Technical Guide	US
13	10,000 Rain Gardens Interpretive Sign	US
14	Bluethumb.org Rain Garden Maintenance Symbol	US
15	Metroblooms.org Raingarden Webpage	US
16	University of Wisconsin Extension Rain Garden Fact Sheet	US
17	Soundimpacts.org Rain Garden Symbol, WA	US
18	Clemson University Master Rain Gardener Symbol, SC	US
19	Missouri Botanical Garden Rain Garden Symbol, MO	US
20	Iowa Department of Agriculture and Land Stewardship Rain Garden Symbol	US
21	Catchin Rain Fort Wayne Symbol	US
22	Red Oak Rain Garden at University of Illinois at Urbana-Champaign Webpage	US
23	City of Bellingham, WA Rain Garden Webpage Symbol	US
24	KeepScotlandBeautiful.org Webpage for Pocket Gardens Rain Garden	US
25	10,000 Raingardens for Scotland Webpage	Scotland
26	Oregon State University Rain Garden Guide	US
27	Joulebug.com Rain Garden Symbol	US
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30	Cumberlandrivercompact.org- Rain Gardens For Nashville, TN Rain Garden Guide	US
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33	Austin, TX Discount Fee Schudle Rain Garden Image	US
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37	Bellweather Agency New York City Green Infrastructure Rain Garden Symbol Designs	US
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42	Prince Georges County, MD Rain Garden Icon	US
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45	Thewaterproject.org- Africa Support- Rain Catchment Symbol	Africa
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53	Hampshire College, MA- Water Diagram- Raingarden Symbol	US
54	RainscapeTO- Toronto, Canada Design Firm Logo	Canada
55	12000raingardens.org- Orcas Love Rain Gardens Symbol	US
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57	Kentucky Waterways Alliance- Every Drop Counts Symbol	US
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63	Chesapeake Bay Trust Rain Garden Webpage	US
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