

# TAKING GREEN TO THE PUBLIC

A look into perceptions and preference of Green Roofs and LID patches.

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## Abstract

Public perception of green roofs and LID practices vary based on a variety of factors. These factors can be purely visual such as plant selection, plant form, color and diversity. They can also be determined by the length at which it is viewed, and which angle it is viewed at. Evolutionary embedded preferences and established cultural views contribute to these preferences. By investigating a number of surveys on green roof preferences from numerous sources we are able to compose a picture of what appeals to the public. By addressing the aesthetic needs of the public we can begin to encourage a more ecological landscape which utilizes LID practices in a multitude of forms beyond the novel green roof.

## Introduction

Low Impact Development (LID) has gained credibility in recent decades as a new approach for sustainably managing storm-water in urban cities. It's benefits exceed those of traditional storm-water management by reducing impacts of storm-water runoff on the built environment and restoring natural hydrological processes.(Huber) With this resurgence of green infrastructure practices, visibility is becoming more prominent with the popularity of green roofs being installed in urban and residential areas. Due to this increased visibility the visual appeal of green infrastructure from the perspective of the public has come into question. Since green roofs are a relatively new phenomenon, research on preferable green roofs has only just begun in the last 10 years.

The aesthetic reactions of green roofs can vary based on a number of factors. Vegetation quality, texture, color and density all contribute

to gaining support and attention from the public. These reactions from the public can also vary based on previously laid values of preferred landscapes. These ingrained values of landscape can be historically driven such as overgrown ivy on the facade denoting a rustic quality or the manicured lawn conveying a higher level of human intervention seen in English gardens. These established attitudes towards landscape can drastically distort perceptions of what is an ecologically suitable green roof and change the very intention of green roofs as a functional part of a larger ecological system.

Due to green roofs being relatively new to North America and becoming increasingly popular, research is needed from a wider demographic to fully address public opinion of green roofs. This research is established in Rachel and Stephen Kaplan's work with landscape preference and touches on the variables that contribute to what shapes landscape preference.

Green roofs play a large role in contributing to storm water mitigation but are just a part of a larger system of interconnected components. The other features of LID such as rain gardens and porous paving options are overshadowed by the novel, more decorative aspects of integrating vegetation with buildings. These less salient features of LID aren't as recognizable in the public sphere due to previously held landscape preferences yet are arguably just as important.

This paper demonstrates that aesthetics of green roofs provided by views to the landscape can drastically change preferences of vegetation

present. In addition, our culturally embedded and evolutionary presets of landscape preferences contribute to the misconceptions of functional LID systems. By investigating the differing reactions to LID interventions with green roofs in mind, we can begin to understand the importance of aesthetics from a point of view of the public, where knowledge of ecology is not as transparent.

## Landscape Preference

During the 1960s and 1970s many environmental psychologists focused attention on the perception of the environment. Stephen and Rachel Kaplan laid the groundwork for creating a functional approach to how we measure landscape preference. The Kaplan's developed an information processing approach to landscape aesthetics in order to explain the interactions between humans and the landscape. The Kaplan's hypothesized that "the perceptual process involves extracting information from one's environment." (Kaplan, Kaplan & Brown, 1989, 514) They suggest that humans seek to make sense of the environment and to be involved in it. They identified four predictor variables, two of which (coherence and legibility) help one understand the environment and the other two (complexity and mystery) encourage its exploration (Fig.1).

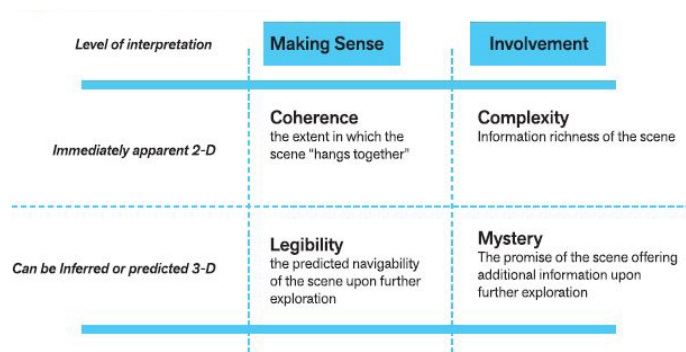


FIGURE 1.

Fig 1. Kaplan's Preference Matrix. Data Adapted from: "Perception and Landscape: Conceptions and Misconceptions, Stephen Kaplan)"

Coherence and Legibility are important in the assessment of certain types of green roofs since in many cases green roofs are inaccessible due to a fixed viewing location. Coherence in this case is at the surface level of analysis where the landscape is interpreted from a 2d perspective similar to a photograph. A scene with high coherence and

legibility would be smooth continuous textures of a grassy plain, in terms of green roofs this sense of continuity is replaced by the integration of greenery and building surface. In this sense a green roof would lack coherence since it draws one's attention from the overall landscape onto one area. However, since the field of view is directed from a fixed position, we can infer that one is looking at the green roof as an enforced container for vegetation, for which we recognize it's isolation from the exterior landscape.

According to Kaplan, In addition to the "surface" analysis of coherence and legibility, there is a rapid and unconscious assessment of what one would experience if they were to proceed "deeper" into the scene. This would be the level of complexity and mystery that encourages people to explore an area. In regards to green roofs, this can be attributed to green roofs in which you can engage with via a courtyard. In terms of the practical application of the preference matrix, the Kaplan's found it explained preference for natural scenes that include views of vistas, as well as elements such as curving sight lines that suggest that there is more to discover in a bend around the corner.

The research generated by the Kaplan's explains that peoples tastes are not random, yet these environmental preferences provide a glimpse into the essential ingredients of how humans function in the environment. We can use this foundational research to explore green roof preference further, drawing on public perception of landscape through an evolutionary lens. The basic landscape qualities that people are drawn to are embedded through what the landscape affords in terms of survival and productivity. These evolutionary traits as described by Kaplan can be summed up in four points:

- Green indicates sustenance
- Flowers indicate future resource potential
- Trees provide shelter/protection from predators
- Grassy under-story is easier to traverse and gains a view of potential predators

With these four underlying points in mind, we can begin to apply them to how we evaluate green roofs. Before doing so however, a difficulty arises in applying Kaplan's preference matrix with the current discussion of LID and green roofs. We have to keep in mind that our collective preferences change over time, and we need to take into account the range of modern variables. These variables include cultural awareness, diversity of experiences, demographic shifts and the current human needs of the landscape. The need to view foliage for its restorative qualities is one of those very needs.

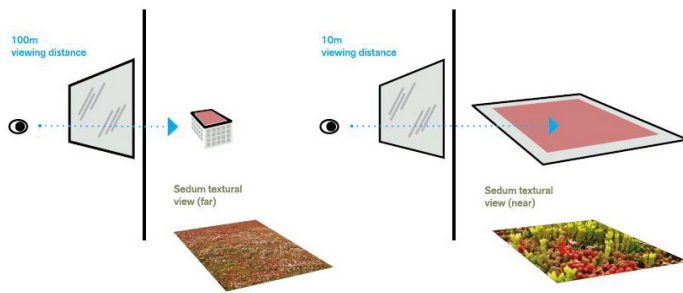


FIGURE 2. *Sedum Roof Vegetation Proximity. Data Adapted from "Map of Three Case Study Green Roofs in Toronto and Sightlines of Participating Buildings who could see the green roof"(Loder)*

## Viewing Proximity

There is a physiological need to view foliage in the urban sphere since it has been proven to alleviate stress and offer a brief but restorative window of calmness (Thompson). Green roofs assist with facilitating these beneficial views to nature yet in certain situations proximity to foliage can be obstructed or be displayed at an extended distance. This distance or obstruction can change the restorative quality that green roofs exhibit and ultimately change peoples preference of the vegetation as well.

Research has been made with viewing proximity in mind, the results of which show that preference of sedum and grass green roofs changes based on the distance viewed. According to research by (Loder)(Fig 2). Participants who viewed green roofs from greater distances (nearby office buildings) preferred prairie like roofs to a sedum one, finding the sedum roof uninteresting at that distance. The comparatively short distance from

which the green roofs were viewed in the current study allowed more textural data to be seen, suggesting that distance is an important factor in the aesthetic perception of green roofs. Textural information and complexity appeal to viewers at a close distance, referring back to Kaplan's research. Information processing theory and prospect refuge theory both suggest that the complexity of visual information in a landscape is key to our aesthetic reactions to it. Increased complexity encourages involvement and richness, two attributes that encourage appeal of green roofs. With grass dominated roofs viewed within close proximity the reaction overall was a "sense of messiness" (Loder) With the viewing distance extended to the nearby office building at under 100m there is a preference for the grassy roofs over the sedum one. This is due to the fact that at a certain distance there is a lack of textural quality with sedums where they appear as a uniform block of red/brown color (Fig 3). The grasses on the other hand were preferred at this lengthy distance since it recalls a prairie ecosystem with green hues reflecting the health of the landscape.

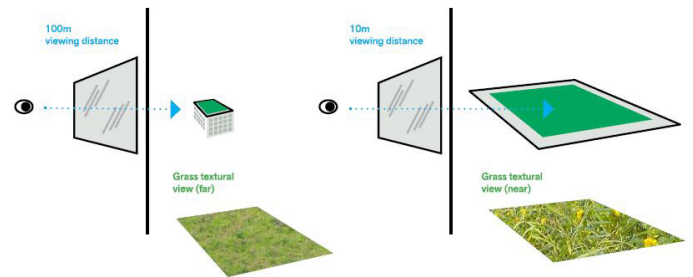


FIGURE 3. *Grass Roof Vegetation Proximity. Data Adapted from "Map of Three Case Study Green Roofs in Toronto and Sightlines of Participating Buildings who could see the green roof"(Loder)*

## Effects of Plant Characteristics & Diversity

Preference for green roofs goes beyond sedum and grass, as there are many variables such as form, structure, type and overall height to be taken into consideration. One other consideration is context of location, as the prior research by Loder was performed in Chicago, where residents recognized the grass dominated roofs as representing a prairie aesthetic. The geographical location of green roofs

can distort opinions of green roofs themselves as people tend to prefer their native communities. (LYONS) The next study occurs in an entirely different climate zone: Australia. In Australia preferences differed according to vegetation characteristics. The most preferred green roof had taller, green, grassy and flowering vegetation while lower - growing red succulent vegetation was least preferred. (Fig 4.)

The results of these findings displayed a marked contrast to the study in Chicago, to which in Australia green grass and high diversity was preferred due to its perceived ecological function. In terms of diversity of planting, mixed foliage color was preferred over mixed form (Fig 5). These findings display preference for a decorative landscape quality over a more ecological, productive one where we would see diverse planting with mixed forms.

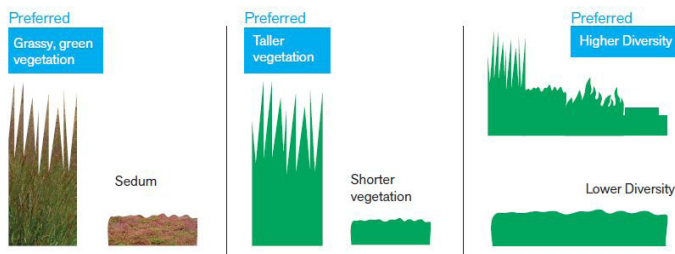


FIGURE 4. Vegetation preference with green roofs. Data Adapted from "K.E Lee et al./Landscape and Urban Planning 122 (2014)"

This isn't necessarily a negative outcome since flowering and color are perceived as an indication of a healthy, productive landscape. (Kaplan) Flowers in this regard may be perceived as cues to human care, which are important in order to increase public acceptance and awareness of Green Roofs and LID practices. Nassauer (1997) says that seeing and understanding connectedness is critical for humans since making connections is all about being human. For example, to Nassauer, common landscapes such as front yard rain gardens communicate the owner's knowledge and may apply an aesthetic of care seen as intention and involvement. These cues to care extend to maintenance of the green roof as well, where lack of care reinforces an overall look of messiness which contributes to a negative complexity of the plants present. This is where sedum roofs excel since compared to intensive

roofs, maintenance is low and cues to care can be based on the planting layout. However, across all the studies the addition of flowering species increased preference and additional green-colored foliage was preferred overall. (Orians & Heerwagen)

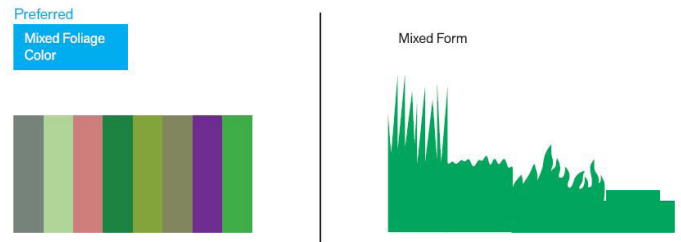


FIGURE 5. Vegetation preferences with green roofs: colour and form. Data Adapted from "K.E Lee et al./Landscape and Urban Planning 122 (2014)"

As designers we can supplement semi-extensive green roofs with flowers, reasoning that this encourages public awareness to actively view the green roofs at different times of the year. Alongside vegetation characteristics, the structural composition of the landscape - including landscape diversity, is important in determining preference. Research indicates that moderately diverse landscapes are most preferred (Orians & Herrwagen) What is interesting about Lee's findings with plant diversity and green roofs are the preferences for high plant diversity over moderate diversity.

Recalling Kaplan's preference matrix once again, we see low diversity (complexity) is perceived as boring whereas very high diversity may be confusing, negating legibility. To counteract these findings we must begin to find a bridge between aesthetics and the ecological function of vegetation. There are risks to having the decorative function overriding sustainable practices as Nassauer (1995) describes: "A neat, orderly landscape (or green roof) seldom enhances ecological function"; they "require control and domination." Our control over the landscape is determined by implementing a sense of order, which more often than not put ecological sensibilities at bay. Overly designed green roofs maintained with appealing to a certain aesthetic often lack biodiversity, ecological structure, and require excessive, costly outside inputs such as water, fertilizer, and labor (Sutton 2013b)



With these constraints in mind, we can utilize preexisting landscape preferences to inform the public about the ecological role that green roofs play a part in. Having a variety of plant forms, foliage color and height can greatly influence green roof preference. These attributes of green roofs coincide with landscapes preference to a certain extent, where we see higher preferences for grassy life-forms and green foliage, which is similar to preferences found in English residential areas.

Preferred evolutionary preferences such as Savannah landscapes with spread out trees and open, easy to traverse grassy under-story(Kaplan) are based on the fundamental need to survive in a landscape. In our modern age we have filled that need for survival yet these preferences still exist. The component of cultural awareness can help us make sense of landscape preferences that are based outside of the evolutionary need for survival. Replacing this evolutionary need is one of maintenance and control. Homeowners need for trimmed hedges and manicured lawns display how decorative qualities gloss over the ecological side that landscape features may take. In order to understand this motivation we must look into the cultural connections of green roof preferences.

## Green Roof Preference based on cultural connections

Past studies have shown that home buyers preferences lean to their already embedded cultural norms as well as the status quo associated with their current subdivisions design.(Nassauer,Wang & Dayrell) Introducing LID practices similar to Green Roofs becomes a challenge due to established preferences that determine consumer value. Add the level of risk involved and ecological practices such as bio-swales and green roofs don't stand a chance. By introducing more pilot projects and promoting green roofs in the public sphere we can alleviate the problem of risk by reinforcing the aesthetic value and economic value side by side. Before we start to introduce designs into the public sphere however, we must first be able to understand perceptions that people hold in terms of plant preference and whether these plants would integrate with their own building.

A study in the UK by White & Gatersleben looked into what homeowners prefer when it comes to buildings being integrated with vegetation. This study is interesting in that it looked at not only green roofs, but included green facades as well. The paper took a critical tone towards promoting all types of green building integration, stating "It is important to determine whether people prefer vegetation over traditional built fabrics, as well as which type of vegetation is preferred, rather than simply advocating nature or greenery in general." The result of the research based on surveys of peoples preferences with building integrated vegetation was that ivy rated highest on each of the measures, followed by meadow, with Sedum, turf and brown vegetations rating lower and being more comparable to the no vegetation condition. (Fig 6.)

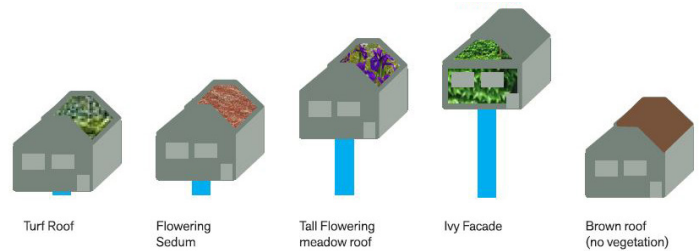


FIGURE 6.  
Building integrated vegetation preference. Data Adapted from "K.E Lee et al./Landscape and Urban Planning 122 (2014)"

The Ivy being rated the highest is surprising, yet completely understandable given the location of the survey given. In the UK there are a considerable number of Ivy-laden houses so those surveyed have a landscape precedent in mind. Ivy is also associated with a certain traditional quality that is rustic and safe. Although all these types of vegetation carry economic and environmental benefits some are more environmentally sound than others. The popularity of Ivy is disconcerting based on the fact that it is an invasive plant that requires routine maintenance. This displays a lack of knowledge about the ecological role of certain plants and the importance of aesthetics in guiding preference. This lack of awareness is not only limited to green roofs as it also applies to LID practices as well.

## Public perception of LID practices

Green roofs are just an component of LID but

contribute to a larger interconnected system that can be scaled outwards from a single house to an entire region. Bioswales, rain-gardens and permeable paving are all a part of a large list that makes up LID practices starting from the residential level. The perceptions of green roofs and LID vary based on the amount of knowledge received. This absence of information and misconception creates what is known as a feedback loop, capable of reinforcing continued use of standard development practices that are not as sustainable.(Bowman) According to research posited by T.Bowman, there are many barriers that exist that keep residents from actively pursuing LID practices. Purchasing opinions contribute to these barriers as we see that the overall look of a subdivision is more important than the ecological components making up the overall look (Fig 7).

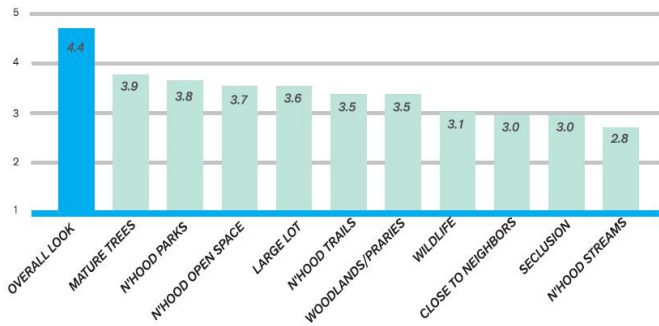


FIGURE 7. Resident opinions on the importance of various neighborhood amenities when purchasing their current residence. Data Adapted from "T.Bowman et al. / Landscape and Urban Planning 107 (2014)"

Add a lack of knowledge about the designs and a unwillingness to pay more for these services and we have a loss of local implementation of LID. We can alleviate these shortcomings by increasing visibility of the attributes of LID, making their function explicit. Yet it is difficult in certain circumstances where water quality or pollution abatement is involved (Gocmen,2006;Thompson)This is where we as designers can tap into preexisting landscape preferences in order to communicate LID in an aesthetically pleasing manner where the ecological process can begin to reveal itself. In order to encourage public awareness of these new forms of storm-water management we must first understand current public perceptions of LID.

In a study by Huang, QI, he looked at the perception of LID practices from Berkeley California in order

to understand how much people know about LID and which factors influence their perception of LID. (Fig 8). Overall, green roofs were the most popular feature of LID, due in part to their rising popularity and novel designs. Other less decorative features of LID such as vegetated swales and permeable pavement received considerably less attention, due to lack of information and awareness in the public sphere. However with this newly found information

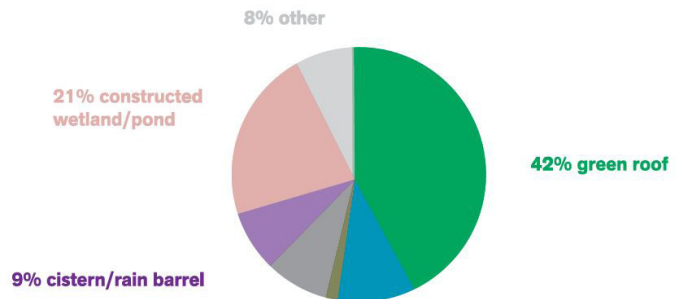


FIGURE 8. Familiarity with LID practices in Berkeley, California. Data Adapted from Qi Huang "Residents' Perception of Low Impact Development in Berkeley" nature.berkeley.edu, (Spring 2013)"

in mind, forty-nine (61%) respondents were most interested in having a green roof and permeable pavement on their property or street . Yet 40% of them would not like the city government to conduct pilot projects on their property or street(Huang 2013) Nassuer explains that "people may care about improving ecological quality but not at the expense of their own landscapes." People have a preconceived notion what they want their neighborhood to look like and fear of looking "messy" stops LID practices before they have a chance to start.

These new forms of treating storm-water are met with hesitation and risk from the public due to how the problem is framed. This new landscape of Low Impact Development requires pilot projects that increase visibility and awareness which requires placing it in the public sphere. By framing LID as an established landscape feature we can allow it to become acceptable and adaptable to human needs of aesthetics and order. There is a risk inherently involved with the addition of these practices in the short term so communication of positive applications and incentives are key. A well-informed public can increase the demand for LID and offers developers and city staff more cost-effective

opportunities and choices in implementing LID as well (Bowman and Thompson 2009, Bowman et al. 2012).

## Conclusion

By investigating the multitude of opinions of green roofs and LID preferences across the globe we are able to ascertain that no conclusive agreement is to be found on what the ideal green roofs should be. This is due to the many variables that shape and form the public opinion and the already established cultural associations of landscapes that are difficult to change.

We as designers must negotiate a middle ground between messiness and order, finding a balance between the ecological sensibilities of LID and the aesthetic needs of the public. A step in the right direction is research that uncovers public preference not only of green roofs, but also LID practices in general and how they are integrated into everyday spaces.

By gathering more information from a larger demographic we can begin to understand how to mark a cultural shift from the necessity of decorative landscapes with large amounts of maintenance to accommodating a new ecological landscape where the aesthetic qualities are derived from its function.

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