

An Assessment of the Seattle Green Factor:  
Increasing and Improving the Quality of Urban Green Infrastructure

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## **CHAPTER 1 – Introduction**

The Seattle Green Factor is an innovative approach for adding green infrastructure into an urban area. This regulation was adopted by the City of Seattle in December 2006 with the intent of adding ecological function and visible vegetation in the city by establishing new minimum requirements for new development projects. Research from this thesis will inform the City of Seattle how the regulation is currently being applied and perceived by designers and developers. Since the Seattle Green Factor (SGF) is the only regulation in the U.S. that uses a weighted point score system for various types of landscapes for new building construction, these results will be particularly useful for other cities considering adoption of similar regulations.

### **Context**

Cities around the world are being planned using the principles of sustainability. City planners, urban designers, architects, landscape architects, engineers, and citizens are becoming increasingly aware of how vegetation and permeable surfaces serve an important role in mitigating the urban heat island effect and reducing excessive stormwater runoff. Today, green infrastructure techniques are being applied to new building developments in cities around the world in the form of incentive-based and mandatory regulations.

The U.S. has rapidly converted rural and agricultural lands to urban uses. From 1982-2001, about 34 million acres of rural or undeveloped land were converted to

developed uses. This was quadruple the cumulative acres that were converted during the prior fifty years. These lands have been converted into homes, parking lots, shops, and offices. It has become increasingly clear that sprawl and urbanization lead to harmful changes in the environment, the economy, and communities. Specific problems include loss of biodiversity, air pollution, reduction of natural functions to absorb stormwater runoff, clean water, and loss of habitat.<sup>1</sup> Overall, population is growing and pushing both inward and outward. In 2008, for the first time in history, more than half of the world's population, or 3.3 billion people, will live in cities.<sup>2</sup> It is estimated that by 2030, 61% of the population will live in urban areas.<sup>3</sup> This growth will require new planning methods for the future of our cities.

The earth is warming up. Consequently, glaciers are melting, and plants and animals are becoming extinct. Scientists are now in agreement that CO<sub>2</sub> emissions and other greenhouse gases are the cause of these momentous changes. Governments around the world have responded with regulations and preventative measures to counter the effects of climate change. Despite the ratification of the Kyoto Protocol in 2005 to reduce CO<sub>2</sub> emissions in developing countries, the U.S. has not taken significant steps to curb emissions.<sup>4</sup> If massive global catastrophes are to be averted, many believe that it will be up to the U.S. to lead the way. Due to this lack of federal leadership, local governments in the U.S. are developing sustainability policies.

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<sup>1</sup> Mark A. Benedict and Edward T. McMahon, *Green Infrastructure* (Washington, DC: Island Press, 2006), 5-11.

<sup>2</sup> UN Population Fund, *UNFPA State of World Population 2007: Unleashing the Potential of Urban Growth*, 2007.

<sup>3</sup> Mike Jenks and Nicola Dempsey, eds., *Future Forms and Design for Sustainable Cities* (Oxford: Architectural Press, 2005), 1.

<sup>4</sup> Elizabeth Kolbert, *Field Notes from a Catastrophe* (New York: Bloomsbury, 2006), 148-170.

Over the last two decades, efforts to reduce environmental impacts have gained increasing momentum. Sustainability-oriented policies are now enacted in U.S. communities of various sizes throughout all parts of the country.<sup>5</sup> The efforts of the sustainability movement primarily stem from the work of the UN World Commission on Environment and Development's 1987 Brundtland Commission's report. It defined sustainable development as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs." Following this report, the 1992 UN Conference on Environment and Development and the Local Action 21 mandate from the 2002 Johannesburg Conference contributed to the momentum of sustainability-oriented development.<sup>6</sup>

In the planning arena, there are different approaches for creating and maintaining sustainable urban areas. A radical approach focuses on structural change that may bring together separate departments, such as economic development, transportation, and planning. An incremental approach starts with the "low-hanging fruit", in which implementable actions are taken in order to build long-term support for sustainability.<sup>7</sup> It may be stated that the Seattle Green Factor blends these two approaches by putting landscape policies for new building construction in a central position within the development process, though still on a small, achievable scale.

In December 2006, The City of Seattle passed the Seattle Green Factor. It is the only building code regulation in the U.S. to require a minimum score for

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<sup>5</sup> Edward J. Jepson, Jr., "The Adoption of Sustainable Development Policies and Techniques in U.S. Cities," *Journal of Planning Education and Research* 23 (2004): 237.

<sup>6</sup> Maria Manta Conroy and Timothy Beatley, "Getting it Done: An Exploration of US Sustainability Efforts in Practice," *Planning, Practice & Research* 22, no. 1 (February 2007): 25-26.

<sup>7</sup> *Ibid.*, 27-28.

landscapes based on a weighted point system. The intent of the regulation is to increase ecological function and visible vegetation, as well as to provide a flexible policy for developers. SGF is modeled after a similar regulation in Berlin, the Biotope Area Factor. Under this program, each parcel is required to mitigate its negative environmental impact on site through vegetation and pervious features. The purpose of this research is to show how the SGF is being applied and how the professional community has received it.

The scope of this research assesses the application of the Seattle Green Factor by developers and designers, by analyzing Master Use Permit applications (MUPs) and conducting face-to-face interviews. Feedback from interviews within those in the professional design and development community most familiar with the regulation aided in the interpretation of submitted MUPs. The initial scope of work proposed examining the built landscapes of constructed buildings. As of April 2008 however, there were no completed site developments. This reality reduced the scope of the research. Therefore, this project addresses predicted ecological results through analyzing permits, rather than studying the actual landscape health and function of built landscapes.

The main research questions focused on which landscape elements were selected, what was the quantity of landscape elements planned, and what aspects of the regulation may be improved to further the City's goals. Based on results of this data collection, recommendations will be formed for improving the Seattle Green Factor.

This study is primarily intended for planners and administrators at the Seattle Department of Planning and Development (DPD) to understand the impact of the regulation. In the first year and a half of the SGF's implementation, DPD recognizes that particular elements and factor weights may need revision. Preliminary results were shared with DPD staff in March '08 since it's in the process of revising the worksheet and making general programmatic improvements. Although the results were not fully analyzed, this initial input provided assistance to DPD for revisions of the SGF worksheet. The final results of this research will contribute to future regulations as the City considers expanding the regulation beyond commercial zones. In addition, Seattle architects, landscape architects, engineers, and developers will benefit from seeing which landscape features are chosen and why. Other cities considering the adoption of a similar regulation may find these initial results useful. It is the hope that this study may form the basis for annual evaluations of the Seattle Green Factor by tracking and analyzing developments from design, construction, and eventually to maintenance.

## **CHAPTER 2 – Overview of the Literature**

City planners, engineers, and designers have used ecological systems as models in the design of buildings, parks, neighborhoods, and cities for over a century. In recent decades, the sustainability movement has once again brought ecological design and planning to the forefront. The benefits of nature in urban areas are many, including the improvement in air quality, reduction in temperature, and increase in quality of life. More policies are being enacted at the municipal level around the world to design the built environment around natural systems.

### **Role of the Landscape Architect in U.S. City Planning**

The roots of modern day planning date back to contributions made by landscape architects in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries. Their designs of large-scale parks and greenways used environmental systems for guidance and inspiration. One of the first pioneers to incorporate green open space into planning was landscape architect Frederick Law Olmsted, the designer of Boston's park system. This system was expanded upon by one of Olmsted's pupils, Charles Eliot, who designed a regional park system for Boston. A contemporary of his, H.W.S. Cleveland, planned a greenway system for the Minneapolis Region. By the turn of the 20<sup>th</sup> century, the Olmsted brothers, Charles Eliot II, and Henry Wright were basing the design of cities and metropolitan parks on the principles of hydrological and natural systems, and

combining that with recreational activities.<sup>8</sup> These efforts continued throughout the 1920s and 1930s with the Regional Planning Association's advocacy for the preservation of greenbelts in regional planning, and development of park systems in almost every city across the nation.<sup>9</sup>

### **Development of U.S. City Planning**

The development of U.S. city planning was due in part to the efforts of landscape architecture and the health and housing reform movement. Reform in planning laws began during the public health crisis in the 19<sup>th</sup> century when improvements were made to the public water and sewer systems, and housing conditions. The basic foundations for city planning came out of the First National Conference on City Planning and the Problems of Congestion Meeting held in Washington D.C. in 1909. This was an attempt to coordinate standards between agencies.<sup>10</sup> In the 1920s, the Regional Planning Association of America was formed. One of the core beliefs of this group was that communities and economies should be scaled to the ecological confines of a region. They believed that a region was the appropriate scale to create self-sufficient communities, thereby reducing environmental problems.<sup>11</sup>

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<sup>8</sup> J.G. Fábos, "Greenway Planning in the United States: Its Origins and Recent Case Studies," *Landscape and Urban Planning* 68 (May 2004): 322-325.

<sup>9</sup> George F. Thompson and Frederick R. Steiner, *Ecological Design and Planning* (New York: John Wiley & Sons, Inc., 1997), 12-16.

<sup>10</sup> Eran Ben-Joseph, "Facing Subdivision Regulations," in *Regulating Place, Standards and the Shaping of Urban America*, eds. Eran Ben-Joseph and Terry S. Szold (New York: Routledge Press, 2005), 172-173.

<sup>11</sup> Scott Campbell, "Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development," *Journal of the American Planning Association* 62, no. 3 (1996): 296-312.

Concern for city reform culminated in the early U.S. zoning and planning regulations. In 1916, New York City was the first U.S. municipality to adopt a comprehensive system of zoning. It regulated land use, building height, and the percentage of lot allowable for buildings to ensure light and air. Most importantly, this act separated industrial and residential land uses. In 1926, forty-three states had adopted zoning acts, but not until that year was the zoning technique ruled constitutional in the pivotal case of *Village of Euclid, Ohio v. Ambler Realty Co.*<sup>12</sup> The Standard City Planning Enabling Act of 1928 was published by the federal government to standardize building and land development.<sup>13</sup> Since this time, zoning has become the most significant form of land use control and separation. Present-day regulations such as the Seattle Green Factor can be attributed to this tradition of zoning.

### **Role of Ecology**

Advances in ecology were taking place while landscape architecture and city planning were emerging as professions. George Perkins Marsh argued as early as 1864 in his classic, “Man and Nature, or Physical Geography as Modified by Human Action,” for the use of nature to mitigate man’s tendency of destroying the environment. Numerous biologists and scientists advanced the field of ecology including Frederick Clements, Henry Cowles, and Herbert Gleason. Their studies of plant communities in the 1920s provided an understanding of the dynamic nature of

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<sup>12</sup> Daniel R. Mandelker et al., *Planning and Control of Land Development: Cases and Materials*, 6<sup>th</sup> ed. (Newark: Lexis Nexis Press, 2005), 209-211.

<sup>13</sup> Ben-Joseph, 173.

landscapes.<sup>14</sup> These individuals were among many who sought ways to use ecological principles to reduce man's impact on the landscape to better steward the land.

Planning, which fully emerged as a profession in the 1920s, was slow to integrate ecological principles. In recent decades, however, there has been a growing interest in understanding how natural systems continue to function in the built environment. This movement has been described in many ways: green urbanism, green infrastructure, urban sustainability, and natural or ecological cities. According to Rutherford Platt, "Whatever the term, something new is happening. Until approximately the 1980s, cities and nature were widely viewed as mutually exclusive."<sup>15</sup> Much of this change has been attributed to Ian McHarg, whose 1969 book *Design with Nature*, promoted natural factors rather than sole reliance on technological fixes in planning practices.

During the 1960s and 1970s, the practice of landscape architecture focused on public sector jobs in urban design, regional planning, environmental impact assessment, and site planning.<sup>16</sup> Anne Whiston Spirn urged cultivating the city like a garden in her 1985 book *The Granite Garden*. More recently, the scientific community has argued that cities and nature are not mutually exclusive. Paul Ehrlich and Gretchen Daily coined the term 'ecological services' to describe such a dynamic relationship. These services provided by nature include air purification, flood and drought mitigation, regeneration of soil fertility, and dispersal of seeds.<sup>17</sup>

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<sup>14</sup> Thompson and Steiner, 13-16.

<sup>15</sup> Rutherford H. Platt, "Toward Ecological Cities," *Environment* 46, no. 5 (June 2004): 21.

<sup>16</sup> Michael Laurie, "Landscape Architecture and the Changing City," in *Ecological Design and Planning*, eds. George F. Thompson and Frederick R. Steiner (New York: John Wiley & Sons, Inc., 1997), 156.

<sup>17</sup> Platt, 22.

These scholars and professional practitioners have played a significant role in elevating the importance of natural systems in urban areas. Today, ecologist James Karr argues that it is crucial that ecology be an integral part for those in the planning and design professions who work between many disciplines and are responsible to the public at large.<sup>18</sup> These professionals have the opportunity to shift our built environment toward sustainable practices.<sup>19</sup>

### **Sustainable Cities Movement**

Cities around the world are responding to environmental degradation by enacting numerous sustainability policies. With the publication of the Brundtland Report in 1987, the Rio Summit in 1992, and Local Agenda 21 from the Johannesburg Conference in 2002, the sustainable development movement has continued to gain momentum. One result of this movement has been that municipalities around the world are enacting sustainability-related policies.

A survey conducted in 2001 by the Department of Urban and Regional Planning at the University of Tennessee-Knoxville attempted to determine the frequency and type of U.S. sustainability-related policies. Among communities of all sizes, it was found that there is a wide range of policies focused on sustainable development in which planning departments played an important leadership role. In particular, policies with the most action taken by local municipalities tended to be related to land development and land use planning. While it is not clear why certain

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<sup>18</sup> James R. Karr, "What from Ecology is Relevant to Design and Planning?," in *Ecology and Design*, eds. Bart R. Johnson and Kristina Hill (Washington, D.C.: Island Press, 2002), 134.

<sup>19</sup> Daniel E. Williams, *Sustainable Design* (Hoboken: John Wiley & Sons, Inc., 2007), 14-15.

cities are more active than others at enacting policies, sustainability-related policies are sprouting up around the nation.<sup>20</sup>

In 1999, The World Green Business Council (WGBC) was formed with the goal to establish green building councils around the world.<sup>21</sup> The U.S. Green Building Council's (USGBC) innovative standard, Leadership in Energy and Environmental Design (LEED), is one widely used tool. Since 2000, when the LEED rating system was adopted, dozens of U.S. cities have mandated that new and existing public buildings must satisfy LEED certification levels (certified, bronze, silver, gold, or platinum).<sup>22</sup> Many countries are adopting similar green building standards: Germany, India, and the United Kingdom. In June 2005, The United Nations World Environment Day brought together mayors from 50 cities around the world to sign the Urban Environmental Accords. One of the action items was for cities to pledge to adopt green building standards in their cities.

While LEED is helping to transform the building industry, it does not necessarily advance ecological site design. Many buildings become LEED-certified without fully addressing the environmental impact or contribution of the site construction. Going beyond LEED, there is an opportunity to treat buildings as part of the site by replacing traditional roofs and impermeable pavement. This strategy is referred to as "urban green" by Seattle-based civil and structural engineering firm,

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<sup>20</sup> Jepson Jr., 237-238.

<sup>21</sup> Charles Lockwood, "Building the Green Way," *Harvard Business Review* (June 2006), <http://www.charleslockwood.com/index.html> (accessed September 27, 2008).

<sup>22</sup> Conroy & Beatley, 30.

Magnusson Klemencic Associates.<sup>23</sup> As discussed earlier, green roofs, façades, and streets as “urban green” play a critical role in reducing the urban heat island effect.

A new rating system at the site level may rival LEED as the more appropriate rating system for landscapes. The Sustainable Sites Initiative is an interdisciplinary partnership between the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center, the United States Botanical Garden, and other stakeholders. The goal is to produce landscape standards, metrics, and recommendations to supplement green building guidelines and serve as a tool for site sustainability. A series of tools is being designed for use in the landscape industry or planning field. By 2011, a rating system for sustainable sites will be available. The first draft report, *Standards and Guidelines: Preliminary Report*, was released on November 1, 2007 for comments. The report outlined general goals and strategies for site design, a site assessment checklist, and a target schedule for implementation. The main argument is that “site design can be improved to protect and regenerate the landscape’s ability to regulate the climate, clean air and water, and improve our quality of life.”<sup>24</sup> The challenge of standards and best practices face every design and planning profession.

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<sup>23</sup> Drew Gangnes, “How Buildings Can Help ‘Reforest’ a City,” *Daily Journal of Commerce* (November 18, 2004), <http://www.djc.com/news/ae/11163020.html> (accessed September 20, 2008).

<sup>24</sup> Sustainable Sites Initiative, *Standards & Guidelines: Preliminary Report*, <http://www.sustainablesites.org/report.html> (accessed April 14, 2008).

## Planning Regulations

A major challenge is how to assert public good over private development. There are a number of ways that government controls and incentives in zoning ordinances can influence private development. Traditional controls, generally prescriptive, are often negative and emphasize what is not allowed, such as building limits or setbacks. Instead, specifying what can be done to achieve design objectives is a positive approach. For example, requiring build to the lot line instead of setbacks encourages more street activity and requiring planting buffers in plazas or streets will help the city create its desired urban design.<sup>25</sup>

Specifically, performance zoning has been described as a flexible method for planners to provide urban infrastructure needs while setting minimum levels for natural processes. Even more flexibility can be added with the use of a point-based rating system, such as the Seattle Green Factor, which assigns multipliers to designated natural processes. True “performance based planning”, which focuses on the function of intensity rather than the land use, is difficult to implement because developers and the community seek predictability. Other drawbacks of “performance based planning” include the difficulty of maintaining consistency among developments, and the longer time and cost involved in administering these systems.<sup>26</sup> The most effective form of

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<sup>25</sup> Jonathan Barnett and Gary Hack, “Urban Design,” in *The Practice of Local Government Planning*, eds. Charles J. Hoch, Linda C. Dalton, Frank S. So (Washington, D.C.: International City/County Management Association, 2000), 336.

<sup>26</sup> Douglas C. Baker, Neil Sipe, and Brendan J. Gleeson, “Performance-Based Planning: Perspectives from the United States, Australia and New Zealand” (lecture, Planning Institute of Australia Queensland Division State Conference, July 16, 2004), <http://www.griffith.edu.au/school/evp/Papers/SipeGleesonBakerPIApaper.pdf> (accessed September 20, 2008).

zoning is thought to be hybrid models of performance/prescriptive zoning that combine traditional zoning techniques with performance-based standards.

European cities offer many examples of urban greening and urban ecology initiatives and regulations. Ecological corridors, green roofs, green walls, green streets, city farms, green schools, and habitat restoration are all such examples. These methods demonstrate how urban areas can improve ecological function. According to landscape architect Timothy Beatley, Europeans believe that nature should be present in cities. In the U.S., the challenge lies in dismantling the assumptions about the distinctions between urban and natural where little emphasis is placed on planning nature in urban areas.<sup>27</sup> Despite this, there is a growing movement to restore the ecology in American cities.

### **Importance of Urban Greening**

Cities around the nation are implementing strategies to provide more green infrastructure in urban areas. Much of the trend to restore nature in cities can be viewed in terms of the overall effort to reduce sprawl and the harmful impact on building in greenfields. Communities are enacting *smart growth* strategies to promote affordable, livable, and environmentally sensitive development. To achieve these goals, several U.S. states have required counties to enact urban growth boundaries to limit growth in already built environments, thus protecting farms, forests, and rural

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<sup>27</sup> Timothy Beatley, "Green Urbanism in European Cities," in *The Humane Metropolis*, ed. Rutherford H. Platt (Amherst: University of Massachusetts Press, 2006), 311-312.

areas.<sup>28</sup> One method to promote high density, compact cities for residents is to focus planning efforts on the “restoration of a vibrant urban green infrastructure of healthy streams, fish and wildlife habitat, parks, and recreational trails where the vast majority of our population lives: namely, in our cities.”<sup>29</sup> As population increases, this strategy of increasing nature in cities will continue as a method to counter sprawl in rural and undeveloped areas.

In the urban areas, most of the natural processes have been replaced by artificial ones. Despite the predominance of hardscape or impervious surfaces, urban areas still contain living organisms that interact with the natural and built environment. Therefore, the city is considered an ecosystem in which people are an essential component.<sup>30</sup>

Urban infrastructure can be described as green or gray infrastructure. Soils, grasses, trees, and shrubs make up green infrastructure. The porous aspect of green infrastructure allows water to soak into the soil, rather than quickly running off. Trees are an important part of this green infrastructure for their role in reducing stormwater management costs, lowering urban heat island temperatures, improving air quality, and ultimately reducing energy consumption.<sup>31</sup> Typically, roads, sidewalks, buildings, and utilities compromise gray infrastructure. The man-made structure of gray infrastructure is impervious, and when dominant, it disrupts natural cycles. This contributes to flooding, higher costs of stormwater management, and lower water

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<sup>28</sup> Benedict and McMahon, 11-12.

<sup>29</sup> Michael C. Houck, “Respecting Nature’s Design in Metropolitan Portland, Oregon,” in *The Humane Metropolis*, ed. Rutherford H. Platt (Amherst: University of Massachusetts Press, 2006), 75.

<sup>30</sup> Thompson and Steiner, 30-31.

<sup>31</sup> Gary Moll, *Trees: The Green Infrastructure* (Washington, D.C.: International City/County Management Association Press, 2002), 4-6.

quality. While the distinction can often be made between green and gray infrastructure, there are exceptions. Porous paving is now available for sidewalk installation and cisterns can be used for rainwater collection.

Recent studies in environmental psychology show that the presence of trees in public housing neighborhoods reduces violent behavior and leads to better neighbor relationships. Studies in schools demonstrate that academic settings in close proximity to natural environments reduce ADHD symptoms and contribute to more academic self-discipline in girls. Additionally, hospital studies show that patients with a view of nature recover more quickly and require less pain-relieving medication. Finally, workers report greater productivity, job satisfaction, and less illness when there is a view of nature.<sup>32</sup>

Studies of the streetscape also point to the importance of designing urban landscapes. Surveys were conducted in U.S. cities to measure the value of trees in revitalizing business districts. Results showed that individual ratings of business districts were higher with the presence of trees and well-maintained streets. Findings show that when trees are the first element encountered by a shopper before entering a store, the longer their shopping visit. This would suggest that the marketing of trees can improve the economic development in a community.<sup>33</sup>

Cities have been altered significantly from their natural state. They have higher temperatures than adjacent rural areas, more impermeable surfaces, increased carbon

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<sup>32</sup> Kathy Wolfe, *Civic Nature: Valuation: Assessments of Human Functioning and Well- Being in Cities*, (paper, US Society for Ecological Economics Conference, Tacoma, WA, July 2005): 4.

<sup>33</sup> Kathy Wolfe, "Business District Streetscapes, Trees, and Consumer Response," *Journal of Forestry* 103, no. 8 (December 2005): 399-400.

dioxide, and less biodiversity.<sup>34</sup> To mitigate these impacts, planners are looking for solutions by incorporating ecological services into the urban environment. The Ecological Society of America defines ecological services “as those that provide “services” that moderate climatic extremes, cycle nutrients, detoxify wastes, control pests, maintain biodiversity and purify air and water (among other services).”<sup>35</sup>

The impact of urban greening related research supports the codification of green infrastructure regulation. A recent study in Manchester, UK modeled several scenarios for green infrastructure using different patterns of green cover with building form. The result showed that green roofs, façades, and streets play a critical role in reducing the urban heat island effect. Green spaces combined with increased stormwater storage, in the form of swales or detention ponds are necessary to moderate surface runoff.<sup>36</sup> Therefore, designing sustainable parcels and adjacent rights-of-way can increase ecological benefits.

Another study in the UK showed that the main influence on ecological performance was the proportion of green space, especially of tree cover. One result showed that the more affluent neighborhoods, with their lower housing densities, demonstrated higher ecological performance. This was due to the greater proportion of green spaces. Another observation found that a compact city would likely have poorer ecology as a result of less green space. As suggested by scholars Whitford, Ennos, and

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<sup>34</sup> V. Whitford, A.R. Ennos, and J.F. Handley, “City Form and Natural Process-Indicators for the Ecological Performance of Urban Areas and their Application to Meyerside, UK,” *Landscape and Urban Planning* 57, no. 2 (November 2001): 1.

<sup>35</sup> Jack Ahern, “Green Infrastructure for Cities: The Spatial Dimension,” in *Cities of the Future Towards Integrated Sustainable Water and Landscape Management*, eds. Vladimir Novotny & Paul Brown (London: IWA Publishing, 2007), 268.

<sup>36</sup> S.E. Gill et al., “Adapting Cities for Climate Change: The Role of the Green Infrastructure,” *Built Environment* 33, no. 1 (2007): 127-130.

Handley, “We might increase vegetation cover by developing turf roofs, growing climbing plants, or developing communal gardens with extensive tree planting....or we might develop building materials which absorb less energy, or paving which is more permeable.”<sup>37</sup> These finding suggests that planners will need to find innovative ways to incorporate green space into dense urban environments.

In particular, green roofs are recognized as having multiple benefits. In dense urban areas with little room for open space, green roofs provide many important functions; such as less stormwater runoff, improvement in air quality, reduction of the urban heat island effect, increased biodiversity, protection for building membranes, improvement of thermal performance, and increase of sound absorption in buildings.<sup>38</sup> In high-density areas, green roofs and other greening strategies are viewed as creative methods to increase green infrastructure and quality of life.

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<sup>37</sup> Whitford, Ennos, and Handley, 99-100.

<sup>38</sup> Goya Ngan, *Green Roof Policies: Tools for Encouraging Sustainable Development* (Goya Ngan, 2004), <http://www.gnla.ca> (accessed September 21, 2008).

## **Precedent Policies Around the World**

As discussed earlier, a number of cities have enacted sustainability policies, many of which focus on environmental site design. Berlin, Germany, Malmö, Sweden, and Tokyo, Japan have enacted minimum vegetation regulations. Whereas Portland, Oregon and Chicago, Illinois in the U.S. have primarily developed incentive-based approaches to encourage additional green infrastructure in the form of green roofs and stormwater management tools. This list is not comprehensive, but it highlights cities with progressive ordinances that focus on increasing green infrastructure at the parcel level.

### **Berlin, Germany**

The Seattle Green Factor is modeled after an innovative regulation in Berlin: the Biotope/Green Area Factor (BAF). During West Berlin's separation from East Germany during 1945-1990, a significant amount of research and public interest in urban ecology developed in Berlin. The green movement in Berlin led to such policies as the National Environmental Protection Law, which enabled authorities to develop landscape plans for urban neighborhoods.<sup>39</sup> As a result of this movement, the BAF program was implemented in 1997. Today the BAF is legally required in several of Berlin's neighborhoods. It allows each district to establish different administration standards by following the same green target and weighting system.

Under the BAF, new development or renovation of buildings must mitigate their environmental impact on site by implementing green infrastructure techniques.

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<sup>39</sup> Ahern, 280-281.

Such techniques as green roofs, green façades, bioswales, permeable paving, and plantings serve the functions of evapotranspiration, retention of stormwater, protection of natural soil functions, removal of airborne particulates, and improved plant and animal habitat.<sup>40</sup> Green area targets are set for different land uses for parcels of new development. Some examples are residential, public facilities, and nurseries and day care centers at 60%, and commercial/city center and technical infrastructure at 30%.

Extensions and alteration of existing buildings must adhere to green area targets depending on the number of dwelling units.<sup>41</sup> Weights are assigned to different green infrastructure techniques based on their contribution to ecological health. Since the introduction of the BAF, Malmö, Sweden has implemented similar policies as the Berlin regulation.



Figure 1. Green Roof, Berlin, Germany  
*Source:* Berlin Senate Department for Urban Development

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<sup>40</sup> Ibid., 280-281.

<sup>41</sup> Berlin: Senate Department for Urban Development, BAF Biotope Area Factor, [http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index\\_en.shtml](http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index_en.shtml) (accessed August 18, 2008).

## Malmö, Sweden

Malmö is Sweden's third largest city, located in the Öresund region, 20 minutes by train from Copenhagen, Denmark. Today, Malmö is transforming from an industrial city to a knowledge city. The change is most evident in Västra Hamnen (the Western Harbor), a former brownfield site redeveloped into a village with work, study, and residential facilities. The area was selected to participate in a national environmental project to make the Western Harbor an international example of sustainability. The BoO1 housing estate was the first stage of development built for the European Housing Expo in 2001 as the "City of Tomorrow."<sup>42</sup> Once developed, the entire Western Harbor will house over 4,500 residents.<sup>43</sup>

The Quality Programme was established by the BoO1 Expo, property developers, and the city of Malmö in order to establish guidelines for architectural qualities, material selection, energy consumption, and green infrastructure. Landscape architects were required to consult with BoO1 and the city of Malmö in the development of green space for the housing units and courtyards. The Green Space Factor was applied to



Figure 2. BoO1 Courtyard, Malmö, Sweden  
Source: Liz Stenning

<sup>42</sup> Malmö, *Plans and Strategies for Western Harbour*, (city of Malmö, 2006), <http://www.malmo.se/westernharbour> (accessed September 27, 2008).

<sup>43</sup> Malmö, *Western Harbour Facts and Figures 2008* (city of Malmö, 2006), <http://www.malmo.se/westernharbour> (accessed September 27, 2008).

ensure that a diversity of plants, green roofs, green façades, and stormwater retention features were installed. Each element received a multiplier from 0.0-1.0. When added together, the average value of the ecological areas multiplied by their corresponding factors, divided by the total property area must achieve a 0.5 score.<sup>44</sup> (See appendix A for the complete list).

In addition, each garden area must have at least 10 green measures selected from a list of 35 green points. These points consist of such elements as nesting boxes for every apartment, water permeable surfaces, the absence of lawns, and gardens for food cultivation.<sup>45</sup> The constructed housing development features an impressive amount of visible stormwater retention and vegetation features. Due to this policy, 16 of the 22 houses feature green roofs, totaling 48,000 square feet.<sup>46</sup> The Berlin and Malmö examples of minimum landscape regulations served as precedents for Seattle in the development of the Seattle Green Factor.

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<sup>44</sup> Annika Kruse, *Green Space Factor Used in Western Harbour, Malmö, Sweden* (city of Malmö)

<sup>45</sup> Bengt Persson, and Agneta Persson, *Green Points* (city of Malmö, 1999).

<sup>46</sup> Leslie Hoffman, *Green Roofs: Ecological Design and Construction* (Atglen: Schiffer Books, 2005), 70.

## Tokyo, Japan

In 2001, the Tokyo enacted mandatory green roof regulations to address rising temperatures and poor air quality. Tokyo's temperatures are much higher than the surrounding countryside. The average temperatures have risen five times as fast as global warming trends, 3C (5.2F) in the past 100 years. The number of summer time hours where temperature exceeds 86F has tripled in the last 20 years.

One of Tokyo's strategies under this plan requires that public buildings over 250 square meters (2,700 square feet) and privately owned new buildings or additions over 1,000 square meters (10,800 square feet) cover at least 20 percent of their roof surface with greenery. If not met, an annual penalty equivalent to USD \$2,000 is applied. The goal is to install 1,200 hectares (3,000 acres) of green roofs by 2015. In the first year, the total net area of green roofs increased by 564,000 square feet to 1.1 million. No penalties were issued, which indicates that the buildings are in compliance. Many business rooftops are open to the public. This may be attributed to the Japan's commitment to civic responsibility and quality of life.<sup>47</sup>

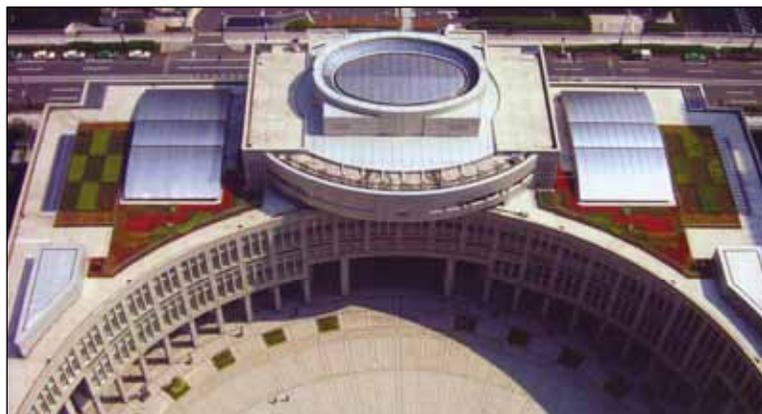


Figure 3. Tokyo Metropolitan Government Assembly Hall, Tokyo, Japan  
Source: Earth Pledge

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<sup>47</sup> Hoffman, 124-126.

## Chicago, Illinois USA

The city of Chicago has embraced green technologies through numerous pilot programs and demonstration projects. The overall approach is to create a culture of sustainable practices by showcasing examples, such as Chicago City Hall, which was retrofitted in 2000 with a green roof covering more than 20,000 square feet and using more than 20,000 plants. Rather than require green roofs or minimum landscape requirements, the city of Chicago is offering incentives for developers to choose green technologies.



Figure 4. Chicago City Hall, Chicago, IL  
Source: Roofscapes, Inc.

Chicago has funded multiple infrastructure programs by way of a multi-million dollar settlement with the Commonwealth Edison Company (ComEd) in March 1999. A \$100 million ‘fund for the future’ is administered by the Chicago Department of the Environment, which has been the seed money to sponsor numerous greening projects.<sup>48</sup> Currently, \$5,000 grants are available toward the cost of a green roof, and \$6,000 grants are offered toward the cost of installing a cool roof. These grants are available for residential and commercial uses, including schools.<sup>49</sup> An energy code adopted in

<sup>48</sup> Conroy & Beatley, 28-29.

<sup>49</sup> The City of Chicago Department of the Environment, under “Initiatives and Programs”, [http://egov.cityofchicago.org/city/webportal/portalEntityHomeAction.do?BV\\_SessionID=@@ @0022305831.1222617844@@ @&BV\\_EngineID=cceadeffimgefjcefecelldfhdfho.0&entityName=Environment&entityNameEnumValue=13](http://egov.cityofchicago.org/city/webportal/portalEntityHomeAction.do?BV_SessionID=@@ @0022305831.1222617844@@ @&BV_EngineID=cceadeffimgefjcefecelldfhdfho.0&entityName=Environment&entityNameEnumValue=13) (accessed September 20, 2008).

2002 mandates a minimum area of reflectivity on new roofs, allowing green roofs or solar panels in addition to reflective roofing materials. The result of these policies has resulted in Chicago being ranked number one in area of green roof coverage from 2004-2007. Total square footage of Chicago's green roofs was 517,633 square feet.<sup>50</sup> The city of Chicago has been a leading municipality in finding innovative ways to raise the awareness of green roof technology and green infrastructure programs with a mixture of incentives, demonstration projects, and policies.

### **Portland, Oregon USA**

The city of Portland uses a mix of mandatory and incentive-based programs to encourage innovative stormwater management techniques and green building construction. All new and replacement projects for city-owned buildings must install a green roof



Figure 5. Green Street, Portland, OR  
Source: City of Portland, Bureau of Environmental Services

with at least 70% coverage and high reflectance material.<sup>51</sup> Other than this requirement, most policies are incentive-based. The city spends a significant amount of resources on education and public outreach to provide awareness and promote

<sup>50</sup> Green Roofs for Healthy Cities, *Final Report: Green Roof Industry Survey 2007* (Green Roof for Healthy Cities, April 2008) <http://www.greenroofs.org/> (accessed August 18, 2008).

<sup>51</sup> Portland Office of Sustainable Development, *Green Building Resolution (2005)* <http://www.portlandonline.com/osd/index.cfm?&a=112681&c=41701> (accessed August 20, 2008).

private stormwater management. Portland has a comprehensive stormwater management program; including stormwater management guidelines, stormwater retrofit projects, a downspout disconnection program, and discounts up to 100% for property owners if stormwater is managed on-site.<sup>52</sup>

Portland's system of tracking green roofs is one of the best in the U.S. Between 2001-2006, 26 green roofs were installed. In 2006 The Clean River Incentive and Discount program went into effect to give discounts on stormwater management fees for green roof construction. Due to this program an additional 23 green roofs were installed between 2006-2007. This recent increase in the number of green roofs indicates the success of Portland's policies.<sup>53</sup>

## **Conclusion**

The preceding case studies highlight a variety of approaches that cities are taking around the world to add green infrastructure. The political leadership of a city can greatly influence what types of policies might be enacted, if any. Creating a culture of 'green' without the use of mandatory regulations, developing a mix of incentive and mandatory regulations, or mandating a certain area or type of land use in a city are all viable options to consider. The following chapter describes one of Seattle's newest strategies to add green infrastructure.

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<sup>52</sup> City of Portland Bureau of Environmental Services, <http://www.portlandonline.com/bes/index.cfm?c=34598> (accessed September 28, 2008).

<sup>53</sup> Timothy Carter and Laurie Fowler, "Establishing Green Roof Infrastructure through Environmental Policy Instruments," *Environmental Management* 42 (July 2008): 162.

## CHAPTER 3 – The Seattle Green Factor

### Context

The Seattle Green Factor was enacted following several years of state mandated growth targeted into urban areas in the Puget Sound Region. The Washington State Growth Management Act (GMA) was passed in 1990 to contain growth in urban areas with the intended goal of sustainable development. The GMA, thought by some scholars to be one of the most advanced in the U.S., requires that cities and counties adopt comprehensive plans to accommodate growth and to meet the goals outlined in the GMA. There are specific implementation measures to control sprawl in the four-county area of Kitsap, Snohomish, King, and Pierce Counties, which hold the greatest percentage of the population in the state, by concentrating development into regional growth centers. The intended outcome will result in higher density housing and jobs in these urban centers.<sup>54</sup>

The City of Seattle Comprehensive Plan, *Towards a Sustainable Seattle*, was adopted in 2005. This 20-year planning document was updated by the Seattle Department of Planning and Development (DPD) and various community stakeholders from the original 1994 comprehensive plan. The updated plan outlines the urban village strategy, which targets growth into designated urban centers. By establishing urban villages, the City expects to meet population growth targets, revitalize neighborhood business districts, invest in existing infrastructure, minimize growth

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<sup>54</sup> Donald Miller and Shi-Chul Lee, "Aiming for Sustainable Urban Development: Experiences with Growth Management Planning in the Metropolitan Region," *Asian Pacific Planning Review* 1 (September 2002): 12-17.

impact on single-family neighborhoods, and reduce automobile dependence. The strategy divides Seattle into 6 urban centers, 6 hub-urban villages, and 18 residential urban villages with diminishing levels of job and housing growth respectively (see Figure 6). The six urban centers are projected to accommodate 60 percent of the residential growth, and 75 percent of the job growth by 2025.<sup>55</sup>

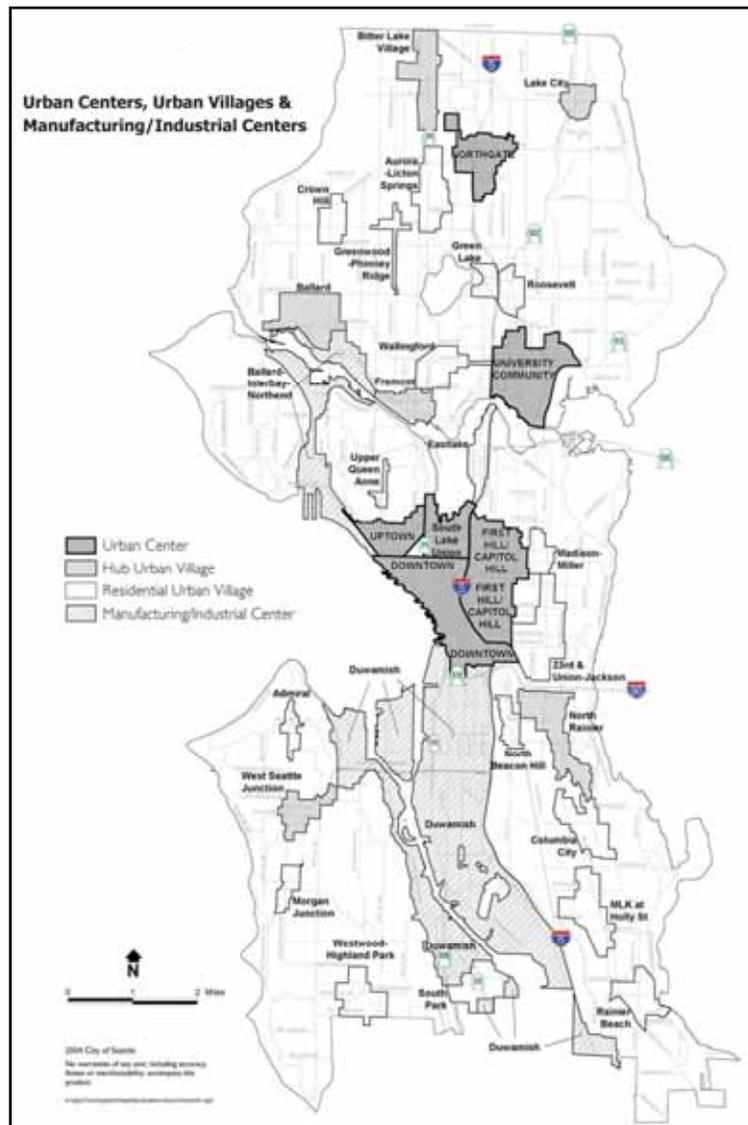


Figure 6. Seattle’s Urban Villages Map  
 Source: City of Seattle Department of Planning and Development

<sup>55</sup> City of Seattle Department of Planning and Urban Development, “Seattle Comprehensive Plan Readers Guide,” [http://www.seattle.gov/DPD/Planning/Seattle\\_s\\_Comprehensive\\_Plan/ComprehensivePlan/default.asp](http://www.seattle.gov/DPD/Planning/Seattle_s_Comprehensive_Plan/ComprehensivePlan/default.asp) (accessed August 24, 2008).

While the Seattle Comprehensive Plan was in the update process, review of the commercial land use code was underway. Over the years, developers, residents, and business owners had expressed concerns with the requirements of Seattle's commercial code. In 2003, an advisory committee comprised of architects, developers, neighborhood residents, business owners, and planners conducted a series of meetings to review the commercial section of the land use code. There were several reasons to evaluate the commercial land use code: (1) the City of Seattle regulations were nearly 20 years old, (2) new policies had been adopted to manage growth since the zoning regulations were revised, (3) new development had given stakeholders new experience and ideas for future development, (4) subsequent amendments to the Land Use Code made the code more complex, and (5) the new design review process allowed for greater flexibility for improving the urban landscape.<sup>56</sup> These issues prompted a strategic planning process for revising the commercial land use code.

The heart of the Seattle urban villages strategy is in the neighborhood commercial districts. These districts are divided into two general zones: pedestrian and automobile-oriented. The Pedestrian-Oriented Zones (Neighborhood Commercial (NC) 1, 2, and 3) are most appropriately located close to neighborhood residential zones. The NC 1-3 zones allows for multi-story residential structures, single purpose commercial structures and mixed-use multi-family housing with business activity on the first floor facing the street. The Automobile-Oriented Zones (General Commercial (C) 1-2) are designed to provide automobile access by allowing a more intensive and

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<sup>56</sup> City of Seattle Department of Planning and Urban Development, under "Project Background," [http://www.seattle.gov/DPD/Planning/Neighborhood\\_Business\\_District\\_Strategy/Overview/](http://www.seattle.gov/DPD/Planning/Neighborhood_Business_District_Strategy/Overview/) (accessed August 18, 2008).

wider range of commercial activities, and to serve as a buffer between industrial and residential areas. In NC and C zones, building heights are applied independently of zoning. In general, the NC1 heights range from 30-40 feet, NC2 heights range from 30-65 feet, NC3 heights range from 40-160 feet, C1 heights range from 40-160 feet, and C2 heights range 30-85 feet.<sup>57</sup>

The former commercial code outlined development standards for height, bulk, density, parking, pedestrian environment, open space, setbacks, landmark districts and structures, the phasing of development for large projects, and regulations to limit negative impacts. Despite these development standards, there were many issues with the old code. There were multiple exceptions, repetition of the same idea, unclear descriptions, long lists of standards with only small variations, and relatively minor landscaping requirements.<sup>58</sup>

City of Seattle oversight of landscape design requirements is held with different departments. The Department of Planning and Development requires landscape design plans from private developments to mitigate adverse effects. The Seattle Department of Transportation oversees street tree requirements and planting strips in the public right-of-way. The Seattle Department of Parks and Recreation is responsible for managing vegetation in the City's parks and recreational lands, and Seattle City Light manages vegetation along power lines.<sup>59</sup> Additionally, Seattle Public Utilities manages

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<sup>57</sup> City of Seattle, *Neighborhood Business District Strategy Background Report*, 2004. Under "Project Background," [http://www.seattle.gov/DPD/Planning/Neighborhood\\_Business\\_District\\_Strategy/ProjectBackground/default.asp](http://www.seattle.gov/DPD/Planning/Neighborhood_Business_District_Strategy/ProjectBackground/default.asp) (accessed August 18, 2008).

<sup>58</sup> *Ibid.*, 14-18.

<sup>59</sup> Seattle Department of Planning and Development, under Tree and Landscaping Regulations, [http://www.seattle.gov/dpd/codes/Tree\\_Landscaping\\_Regulations/Overview/default.asp](http://www.seattle.gov/dpd/codes/Tree_Landscaping_Regulations/Overview/default.asp) (accessed August 19, 2008).

all stormwater and drainage services.<sup>60</sup> This division of landscape oversight adds complexity in the permit process for new developments. Since private developers often plant trees in the right-of-way, or near utility corridors, it can become challenging to adhere to different standards.

The old landscape requirements for the commercial code were part of the open space requirement, enacted in 1988 with no substantial changes until the adoption of the Seattle Green Factor. Sporadic changes had been made to the open space requirement, with the result that more open space was required in commercial zones than for residential development in other zones. Furthermore, open space requirements for large developments could be much higher. Since the open space requirement was connected to building square feet, rather than lot area, this created a disincentive for developers to build denser projects in commercial zones.<sup>61</sup>

The former code required open space at or above the ground for a total of 20% of a structure's residential gross floor area, which could be met by providing roof decks, balconies, or courtyards. This requirement allowed for a wide variety of square footage in open space per building, since the amount was determined by a percentage of the residential floor area.<sup>62</sup> Table 1 (p. 32) shows examples of varying open space due to zone, lot sizes, and number of units. Of this open space area, 30% was reserved for landscape installation, consisting of trees, shrubs, and groundcovers.<sup>63</sup> The Seattle

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<sup>60</sup> Seattle Public Utilities, [http://www.seattle.gov/util/About\\_SPU/Drainage\\_&\\_Sewer\\_System/Plans/StormwaterManagementProgram/index.htm](http://www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Plans/StormwaterManagementProgram/index.htm) (accessed September 27, 2008).

<sup>61</sup> City of Seattle, *Neighborhood Business District Strategy Background Report*, 2004, 65.

<sup>62</sup> *Ibid.*, 62-65.

<sup>63</sup> City of Seattle Department of Planning and Development, *Director's Rule 13-92*, 1992, 3 <http://web1.seattle.gov/dpd/dirrulesviewer/Rule.aspx?id=13-92> (accessed September 26, 2008).

Green Factor replaced these old requirements, but retained the City’s street tree policy.

Table 1. Residential Open Space Requirements: Former Commercial Code

Sample Project	Project Information				
	Zoning	Lot Size (square feet)	Units	Res. Floor Area (square feet)	Open Space (square feet)
1	NC1-30	8,735	8	15,723	3,145
2	NC1-30	11,300	7	7,840	1,568
3	NC1-30	12,688	17	15,041	3,008
4	NC1-30	13,310	18	9,652	1,930
5	NC1-30	36,294	30	31,017	6,203
6	NC2-40	9,884	19	9,600	1,920
7	NC3-40	4,400	8	7,663	1,533
8	NC3-40	6,880	10	9,447	1,889
9	NC3-65	15,750	62	42,441	8,488
10	NC3-65	17,700	57	56,977	11,395
11	NC3-65	19,450	24	20,931	4,186
12	NC3-160	14,400	154	143,398	28,679
13	C1-65	20,283	88	65,420	13,084

Source: Data adapted from City of Seattle, “Neighborhood Business District Strategy Background Report.”

The new commercial land use code, Municipal Ordinance 122311, went into effect in January 2007. The following are the summary of changes outlined by DPD:

- “Applied or expanded pedestrian overlays to commercial cores of neighborhood business districts.
- Removed unnecessary obstacles to housing development in commercial areas.
- Strengthened the pedestrian-orientation of commercial street fronts through development standards and guidelines.
- Refined and simplified the use and maximum size of business standards.
- Revised requirements for residential amenities.
- Increased landscaping requirements providing additional flexibility for different types of plants.
- Controlled building bulk with floor area ratios to encourage wider sidewalks, plazas, ground-level open spaces or view corridors.
- Lowered parking requirements based on demand and to support alternative transportation.
- In Urban Centers and high capacity transit station areas, allowed the market rather than the code to determine appropriate parking supply.
- Simplified the City’s regulations so they are easier to understand.”<sup>64</sup>

<sup>64</sup> City of Seattle, *Commercial Code 2006 Amendments: Neighborhood Business District Strategy* (2007) under “Summary of Changes”

## Seattle Green Factor

Since the adoption of the new commercial land use code in December 2006, new development must now meet landscape design requirements referred to as the Seattle Green Factor (SGF). In commercial zones outside of downtown Seattle, the SGF applies to any new development or redevelopment that exceeds four dwelling units, 4,000 square feet of non-residential uses, or 20 new parking spaces.<sup>65</sup> The program applies to mixed-use development and big box retail alike. The intent of the regulation is to improve the quality of landscapes in both an aesthetic and environmental function. While the SGF requirements are more stringent than the old landscape requirements, the policy was designed to remain flexible for developers.

The map of Seattle Green Factor zones shows where the regulation applies in Seattle (see Figure 7 on the following page). The clusters of green correspond to the various neighborhood districts with commercial zoning. Several commercial zones fall outside of the requirements of the Seattle Green Factor. For instance, the commercial zones in the downtown of Seattle must adhere to the old commercial code open space requirements because it was considered too difficult for high-rise buildings to meet these requirements.

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[http://www.seattle.gov/DPD/Planning/Neighborhood\\_Business\\_District\\_Strategy/Overview/default.asp](http://www.seattle.gov/DPD/Planning/Neighborhood_Business_District_Strategy/Overview/default.asp) (accessed September 29, 2008).

<sup>65</sup> City of Seattle Municipal Code, *Municipal Code 122311*.

[http://www.seattle.gov/DPD/Planning/Neighborhood\\_Business\\_District\\_Strategy/Overview/default.asp](http://www.seattle.gov/DPD/Planning/Neighborhood_Business_District_Strategy/Overview/default.asp) (accessed September 29, 2008).



Figure 7. Seattle Green Factor Zones Map  
Source: City of Seattle Department of Planning and Development

As described

earlier, the inspiration for the Seattle Green Factor arose from a similar regulation in Berlin, Germany, the Biotope Area Factor (BAF), which was enacted in 1994 to apply green infrastructure at the parcel and building scale. The major difference between the two is that the Seattle regulation only applies to commercial land use at this time. The SGF was developed by an inter-departmental team, led by Steve Moddemeyer from DPD, with an initial 2-year time frame to develop the new code. However, this was compressed into six months due to the timing of adopting the new commercial code.<sup>66</sup>

Before the SGF was adopted, the City of Seattle Planning Commission raised concerns to Seattle's City Council. In a November 21, 2006 memo, The Planning Commission stated, "The Commission is ready and willing to assist with further review of this proposal and we remain committed to the goals of the Seattle Green Factor."<sup>67</sup> However, the Commission pointed out the impact on small businesses, responsibility for maintenance of landscaping, and coordination with Seattle Department of Transportation. The Planning Commission recommended keeping the open space requirement for five years, but using SGF as an incentive to waive the open space requirement.<sup>68</sup> These recommendations were not considered, and the Seattle Green Factor was adopted on December 12, 2006. As of January 2007, SGF replaced the old landscaping requirements in the commercial code.

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<sup>66</sup> Steve Moddemeyer, interviewed by author, Seattle, WA, February 17, 2008.

<sup>67</sup> Seattle Planning Commission, *Comments and Recommendations to Seattle City Council*, November 21, 2006. <http://www.ci.seattle.wa.us/planningcommission/commercialcode.htm> (accessed September 27, 2008).

<sup>68</sup> Ibid.

For those sites that fall under the SGF, a worksheet must be completed and submitted to DPD as part of the Master Use Permit (MUP) application. A worksheet for all possible landscape elements is available on the DPD website.<sup>69</sup> (See Table 2 on page 30 for the full list). A minimum score of 0.30 (30%) of the parcel's total area is required for all sites. This score is based on the BAF, but modified to best represent the target of 0.30. This target was selected to match the old number of 30% for landscape of 20% of the open space in the old code.<sup>70</sup>

## Factors

Green roofs, vegetated walls, and porous paving were given higher factors to reflect their multiple benefits, and to encourage broader use of these techniques. Bonus points were also given to landscape features visible to the public. Therefore, the combination of improving ecological function, increasing the number of visible landscapes, and encouraging developers to adopt new practices were the underlying forces behind how the point-based system developed.<sup>71</sup>

The general landscape elements listed on the SGF worksheet include groundcovers, shrubs, trees, permeable



Figure 8. Vegetated Wall, Seattle Capitol Hill Library *Source: Liz Stenning*

<sup>69</sup> Seattle Green Factor, Seattle Department of Planning and Development, <http://www.seattle.gov/dpd/Permits/GreenFactor> (accessed September 30, 2008).

<sup>70</sup> Steve Moddemeyer, interviewed by author, Seattle, WA, May 12, 2008.

<sup>71</sup> Ibid.

pavement, green roofs, vegetated walls, water features, rain gardens, drought tolerant plants, and visible landscapes. There are further explanations of the requirements listed on the worksheet itself. Additionally, the specifics of the ordinance and Landscape Director's Rule are available on the SGF website. The Director's Rule describes the submittal requirements for the MUP, calculation worksheets, and definition of terms.

SGF-compliant projects must meet street tree standards and comply with Seattle Department of Transportation right-of-way standards, but all other landscaping is evaluated according to the SGF scoring system. Developers may choose from a variety of landscape elements on the worksheet including groundcovers, shrubs, trees, green roofs, vegetated walls, permeable paving, water features, and bioretention areas. Each landscape feature is assigned a weighted value ranging from 0.1-0.7. These values are referred to as the "factors". Green roofs, vegetated walls, and permeable paving were given the highest weights to reflect their multiple benefits, and to promote their use. In contrast, the lowest weight of 0.2 is assigned to lawn, ground cover, grass pavers, and shrubs planted in soil less than 2 feet deep. This factor was assigned due to less stormwater retention, shade contribution, and general biomass. In contrast, 0.7 was assigned to lawn, ground cover, and grass pavers planted in soil depth



Figure 9. Vegetated Streetscape, Seattle, WA

Source: Liz Stenning

greater than 2 feet deep. From research and conversation with DPD, it is unclear why such a high factor was assigned to this landscape feature.

Additional bonus points are awarded to landscapes visible to passers-by and drought tolerant plants, weighted at 0.1, to encourage aesthetic function and use less water for irrigation. While bonuses for drought tolerant planting may be surprising to some, given Seattle's reputation as a rainy city, the region experiences a seasonal drought from July to late September and most landscapes require irrigation during that period.

### **SGF Calculation**

To determine the Seattle Green Factor score, you must first multiply the square footage of each type of element (for example the area of a green roof) by the factor assigned to that element (for green roofs the factor is 0.7). Do this for each landscape element, add up the scores and divide by the total square footage of the parcel. A minimum score of 0.30 (30%) of the parcel's total area is required for all sites. There is no minimum as to the amount of elements chosen. A typical project would meet the SGF requirement by using street trees, shrubs and groundcovers around the site, and a green roof or vegetated wall on the structure itself.

1. Choose from 15 landscape elements
2. Multiply the square footage of each element by its multiplier (range from 0.1-0.7)
3. Add up all new areas
4. Divide new total by parcel area
5. Seattle Green Factor Score = 30% of parcel area

Table 2. Seattle Green Factor Worksheet

Source: City of Seattle Department of Planning and Development



SEATTLE *green factor*

FINAL VERSION 3-9-07

	enter sq ft of parcel  Parcel size (ENTER THIS VALUE FIRST)* <input style="width: 50px; text-align: center;" type="text" value="1"/>		You need at least 0.300  SCORE <input style="width: 50px; text-align: center;" type="text" value="-"/>
<b>Types of Area**</b>			
	Square Feet	Factor	Total
<b>A Vegetation planted with a soil depth of less than 24"</b>			
1	Lawn or grass pavers or ground covers	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.2 -
2	Plants and shrubs 3' and higher at maturity	enter number of plants <input style="width: 50px; text-align: center;" type="text" value="0"/> 0	0.3 -
<b>B Vegetation planted with a soil depth of more than 24"</b>			
1	Lawn, grass pavers or other plants less than 3' tall at maturity	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.7 -
2	Shrubs taller than 3' at maturity - calculated at 16 sq ft per plant (typically planted no closer than 18" on center)	enter number of plants <input style="width: 50px; text-align: center;" type="text" value="0"/> 0	0.3 -
3	Tree canopy for "small trees" in SDOT's Street Tree Planting Schedule or equivalent canopy spread of 15' - calculated at 50 sq ft per tree	enter number of plants <input style="width: 50px; text-align: center;" type="text" value="0"/> 0	0.3 -
4	Tree canopy for "small/medium trees" in Street Tree Planting Schedule or equivalent canopy spread of 20' - calculated at 100 sq ft per tree	enter number of plants <input style="width: 50px; text-align: center;" type="text" value="0"/> 0	0.3 -
5	Tree canopy for "medium/large trees" in Street Tree Planting Schedule or equivalent canopy spread of 25' - calculated at 150 sq ft per tree	enter number of plants <input style="width: 50px; text-align: center;" type="text" value="0"/> 0	0.4 -
6	Tree canopy for "large trees" in Street Tree Planting Schedule or equivalent canopy spread of 30' - calculated at 200 sq ft per tree	enter number of plants <input style="width: 50px; text-align: center;" type="text" value="0"/> 0	0.4 -
7	Tree canopy for preservation of "exceptional trees" or trees with trunk diameter exceeding 24" at four and one half feet above the ground. calculated at 250 sq ft per tree	enter number of plants <input style="width: 50px; text-align: center;" type="text" value="0"/> 0	0.5 -
8	Permeable paving that drains only itself. It must be at grade. - calculated per square foot	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.6 -
<b>C</b>	<b>Green roofs</b> - 4" minimum soil depth at time of planting	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.7 -
<b>D</b>	<b>Vegetated walls</b>	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.7 -
<b>E</b>	<b>Water features (fountains) or rain gardens</b> (where allowed by SPU)	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.7 -
		sub-total of sq ft =	0
<b>Bonuses</b>			
<b>F</b>	<b>Landscaping using drought tolerant plants or where at least 50% of annual irrigation needs are met from non-potable sources</b>	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.1 -
<b>G</b>	<b>Landscaping visible to passers-by from adjacent public right of way or public open spaces</b>	enter sq ft <input style="width: 50px; text-align: center;" type="text" value="0"/>	0.1 -
		green factor numerator =	-
<p><i>* Do not count public rights of way in parcel size calculation.</i></p> <p><i>** To calculate your green factor score, you may count the landscape elements that are in public rights of way if they are contiguous with the parcel.</i></p>			

The building sketch in Figure 10 provides a visual illustration for how the minimum score of 0.30 can be achieved. The intent of the SGF is to allow for flexibility in achieving the points, but also to create multiple surfaces to absorb heat, detain rainwater, and improve air quality. The following landscape elements correspond to the Seattle Green Factor worksheet (see Table 2).

**B.1:** Lawn, grass pavers or other plants less than 3' tall at maturity (soil depth > 24")

**B.2:** Shrubs taller than 3' at maturity (soil depth > 24")

**C.7:** Preserved Trees (note: C.7 corresponds to B.7 on the SGF worksheet)

**C:** Green Roof

**D:** Vegetated wall

**F:** Drought tolerant plants

**G:** Landscape visible to passers-by

QuickTime™ and a  
PDF viewer are required to see this picture.

Figure 10. Seattle Green Factor Building Sketch  
*Source:* City of Seattle Department of Planning and Development

While there are specific requirements for each landscape element, many of these are open to interpretation of their intent and proper technique. Additional clarification of landscaping standards and requirements can be found within the Landscaping Director's Rule, found on the SGF website.<sup>72</sup>

### **Sample Project**

The Seattle Green Factor Worksheet in Table 3 (p. 42) illustrates how one project site achieved a factor of 0.306. Note that the total parcel size in this sample project is 7,200 square feet with a green factor numerator of 2,206 square feet. The majority of the points scored were obtained from the inclusion of large trees and the preservation of exceptional trees. The corresponding landscape plan in Figure 11 (p. 43) shows the large street trees, preserved trees, green walls, shrubs, and small plants designed for the street level. This development chose the following elements:

**B.1:** Lawn, grass pavers or other plants less than 3' at maturity

**B.6:** Tree canopy for "large trees"

**B.7:** Tree canopy for preservation of "exceptional trees"

**D:** Vegetated walls

**G:** Landscaping visible to passers-by from adjacent public right-of-way or public open spaces.

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<sup>72</sup> Seattle Department of Planning and Development, *Draft Landscaping Director's Rule*, <http://www.seattle.gov/dpd/Permits/GreenFactor> (accessed September 26, 2008).

Table 3. Seattle Green Factor Worksheet: Sample Project  
 Source: Seattle Department of Planning and Development

SEATTLE <i>green factor</i> 				
<b>FINAL VERSION 1-22-07</b>				
Parcel size (ENTER THIS VALUE FIRST)*		enter sq ft of parcel <input type="text" value="7,200"/>	You need at least 0.300 <b>SCORE 0.306</b>	
Types of Area**		Square Feet	Factor	Total
<b>A Vegetation planted with a soil depth of less than 24"</b>				
1	Lawn or grass pavers or ground covers	enter sq ft <input type="text" value="0"/>	0.2	-
2	Plants and shrubs 3' and higher at maturity	enter sq ft <input type="text" value="0"/>	0.3	-
<b>B Vegetation planted with a soil depth of more than 24"</b>				
1	Lawn, grass pavers or other plants less than 3' tall at maturity	enter sq ft <input type="text" value="1483"/>	0.7	1,038
2	Shrubs taller than 3' at maturity - calculated at 16 sq ft per plant (typically planted no closer than 18" on center)	enter number of plants <input type="text"/>	0.3	-
3	Tree canopy for "small trees" in SDOT's Street Tree Planting Schedule or equivalent canopy spread of 15' - calculated at 50 sq ft per tree	enter number of plants <input type="text" value="0"/>	0.3	-
4	Tree canopy for "small/medium trees" in Street Tree Planting Schedule or equivalent canopy spread of 20' - calculated at 100 sq ft per tree	enter number of plants <input type="text"/>	0.3	-
5	Tree canopy for "medium/large trees" in Street Tree Planting Schedule or equivalent canopy spread of 25' - calculated at 150 sq ft per tree	enter number of plants <input type="text"/>	0.4	-
6	Tree canopy for "large trees" in in Street Tree Planting Schedule or equivalent canopy spread of 30' - calculated at 200 sq ft per tree	enter number of plants <input type="text" value="4"/>	0.4	320.0
7	Tree canopy for preservation of "exceptional trees" or trees with trunk diameter exceeding 24" at four and one half feet above the ground. calculated at 250 sq ft per tree	enter number of plants <input type="text" value="2"/>	0.5	250.0
8	Permeable paving that drains only itself. It must be at grade. - calculated per square foot	enter sq ft <input type="text" value="0"/>	0.6	-
<b>C Green roofs - 4" minimum soil depth at time of planting</b>				
		enter sq ft <input type="text" value="0"/>	0.7	-
<b>D Vegetated walls</b>				
		enter sq ft <input type="text" value="566"/>	0.7	396.2
<b>E Water features (fountains) or rain gardens (where allowed by SPU)</b>				
		enter sq ft <input type="text" value="0"/>	0.7	-
<b>Bonuses</b>		sub-total of sq ft =	3,349	
F	Landscaping using drought tolerant plants or where at least 50% of annual irrigation needs are met from non-potable sources	enter sq ft <input type="text" value="0"/>	0.1	-
G	Landscaping visible to passers-by from adjacent public right of way or public open spaces	enter sq ft <input type="text" value="2,014"/>	0.1	201
			green factor numerator =	2,206
* Do not count public rights of way in parcel size calculation.				
** To calculate your green factor score, you may count the landscape elements that are in public rights of way if they are contiguous with the parcel.				

## Landscape Plan for New Building

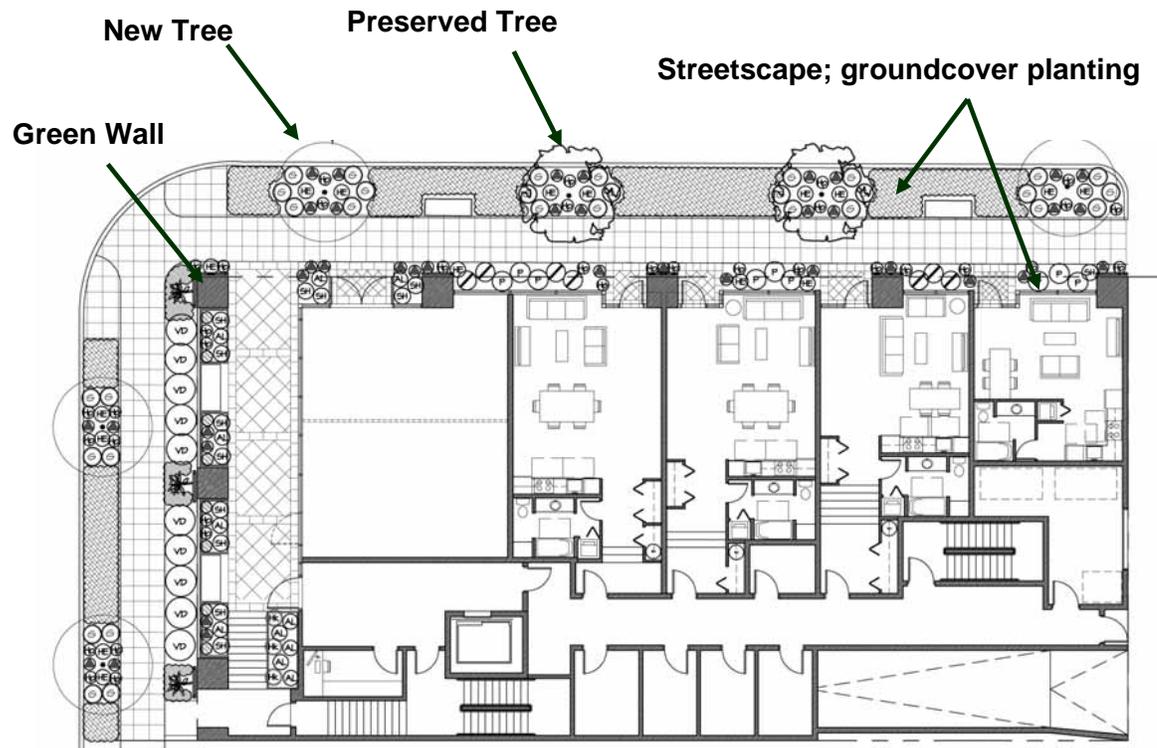


Figure 11. Sample Landscape Plan

Source: Seattle Department of Planning and Development Master Use Permit

## **Conclusion**

The Seattle Green Factor provides a prescriptive, yet flexible method for adding green infrastructure in the city. The adoption of the code stems from the increasing density in Seattle and the desire to mitigate the effects of urbanization. The following chapters describe the research methodology and initial results of how the Seattle Green Factor is being applied and perceived by professional designers and developers.

## **CHAPTER 4 - Methodology**

The scope of this research is to assess the initial results of the Seattle Green Factor. Specifically, this research examines how the regulation is being applied, and how it is perceived by professional designers and developers, and city permit reviewers. Prior to beginning this study, I approached policy staff at the City of Seattle Department of Planning and Development (DPD) to inquire about assessing the new code. DPD policy makers are interested in knowing how the regulation is being applied since it went into effect in January 2007. There is interest in examining whether or not the outcome is meeting the desired intent of improving the ecological and aesthetic quality of the neighborhood commercial districts. Furthermore, DPD intends to make revisions to the Seattle Green Factor to increase options for meeting the requirements by changing the factors for certain elements.

Only a small number of projects will be near completion by the end of this research. Due to the early stage of the regulation, this research will not assess built landscapes since that would involve many more years of study. It is the hope that future research will continue to monitor built projects over time. Therefore, the current scope is limited to analyzing Master Use Permit applications (MUPs) and conducting face-to-face interviews. From this data, it will be determined which landscape features are most frequently selected and in what quantity. Based on the results of this data, policy recommendations are offered in the concluding chapter.

The research method is based on a series of questions.

- How do designers and developers apply the requirements of SGF?
- What is the perception of SGF?
- Which SGF elements do applicants choose?
- What is the quantity of SGF elements for projects?
- What proportion of applicants select SGF elements with the highest factor (0.7) or the lowest (0.2)?

### **Data Collection (Master Use Permits)**

This research is an assessment of the Seattle Green Factor, based primarily on MUP applications. In January 2007, I received a list from DPD of potential MUPs filed from when the regulation went into effect until the present. The original list contained over 120 sites in all commercial zones. The first step was to exclude those projects not located in NC1-3 and C1-2 zones, as they were not required to comply (e.g. the original list contained some commercial sites in the downtown high-rise zone). In order to collect the worksheets and landscape plans, I looked through all available permit applications at the DPD permit office. Since MUPs are not filed electronically until issuance of permits, only paper copies were available. Since many MUPs were under review, I was only able to locate approximately 23 MUPs through this process.

Currently there is no system for tracking the SGF projects in the DPD permit process. It cannot be assumed that a project will need to meet the requirements since it may be under the minimum lot size or number of units. Some projects were vested

with the old code if they submitted the MUP prior to January 2007. Therefore, each MUP had to be physically located, or confirmed by the project developer or architect. Permit data collection for this research occurred from January through April 2008. Approximately one dozen additional projects were referred to me by design teams, permit staff, or from seeing Proposed Land Use signs on parcels under development in the neighborhood commercial districts. Due to the lack of tracking system, it is possible that several MUPs did not make this list.

The next step in MUP data collection was to contact each project applicant to determine whether or not their projects needed to meet the requirements of the SGF. This process uncovered and confirmed many more MUP applications. Owners, landscape architects, and architects graciously sent me worksheets and landscape plans. By the conclusion of the data collection, there were a total of 60 projects, which needed to comply with SGF. Of this total, 42 worksheets were collected. Therefore, the sample size is 70% of the total known SGF sites. Additionally, 34 landscape plans (81%) were collected from this sample. Landscape plans provided information about street frontage, species, materials, and location.

I was not able to obtain additional permit information beyond this amount. Some MUPs were under revision, and were therefore not complete enough for analysis. Some applicants did not respond to my request even after I attempted two to three contacts. In order to finish this research in a timely manner, I stopped collecting permit data when a majority of the information was obtained. It was determined by my committee to be a reasonable sample.

### **Data Collection (Face-to-Face Interviews)**

While collecting MUPs, I simultaneously conducted face-to-face interviews with developers, architects, landscape architects, property owners, and DPD permit review staff from February through April 2008. I interviewed only applicants who had experience adhering to the requirements of the Seattle Green Factor. It was assumed that these professionals would have the most insight into the details of the regulation in terms of understanding the specific categories and the permit review process. I developed two sets of interview questions to specifically answer my research questions. See Appendices C for city staff questions and Appendix E for designer and developer questions. It was unknown whether or not developers would have the same knowledge about SGF as designers. Thus, I chose to ask these professionals the same set of questions. These questions were approved by the University of Washington Human Subjects review, which stipulated that interviews must not be recorded. Due to this restriction, all interview notes were taken by hand, typed, and sent to interviewees for final review. Interviewees signed non-disclosure forms or a verbal agreement was made not to disclose personal information. Names of individuals and project addresses are not presented in this research due to the early stages of project development.

I was advised by my committee to formally interview four to five representatives from each profession. With this recommendation, I interviewed a total of 17 people. However, it should be noted that those interviewed might represent more than one project. For example, one landscape architect is involved with 12 projects, and another architecture firm is working on 4 of these projects. Table 4

summarizes the number of interviewees by profession with the total number of projects represented.

Table 4. Number of Projects Represented by Each Interviewee

	Property Owners/Developers	Landscape Architects	Architects	DPD, SDOT permit review staff
<b>Total interviewed</b>	4	6	4	3
<b>Total # of projects represented</b>	6	18	4	unknown

Data collection from SGF worksheets submitted in MUPs and interviews provided sufficient information to address my research questions. While this data gives a snapshot of the regulation in the first year and four months since its adoption, the results will contribute to revisions of the worksheet and overall program. The following chapter discusses the findings from this research.

## **CHAPTER 5 – Findings from Seattle Green Factor Worksheets**

This chapter summarizes data results from Master Use Permit worksheets. The data shows overall trends in the impact of the Seattle Green Factor by examining which green infrastructure elements are chosen and in what quantity. Further data from interviews from the development and design professions, presented in Chapter 6, explain why certain elements were chosen.

### **Total Number of Seattle Green Factor Projects**

From January 2007 to April 2008, a total of 60 confirmed MUPs that must adhere to the requirements of the Seattle Green Factor were submitted to DPD. An additional 18 development sites may have needed to comply, but no definitive data was located to confirm this. Of these projects, SGF worksheet data was located for 42 of these sites. This sample represents 70% of the total confirmed SGF sites. Additionally, 81% of the landscape plans for this sample of sites were obtained.

### **Geographical Location**

While the Seattle Green Factor does not by itself dictate the location of projects, it is worth noting the zoning districts and neighborhoods for the 60 sites. The sites are distributed throughout all required commercial zones, with the majority of development occurring in NC-3 (see Table 5 on the following page).

Table 5. Seattle Green Factor Project Location by Zoning District (60 sites)

Total projects	NC1	NC2	NC3	C1	C2
	7	14	31	6	2

Neighborhood commercial development is occurring throughout Seattle with the largest group of SGF projects located in the Capitol Hill neighborhood as shown in Table 6. The SGF sites are located in 26 of Seattle's 39 designated urban villages. (See Figure 5 (p. 28) for geographic reference to Seattle's urban villages.)

Table 6. Location of Seattle Green Factor Sites (60 sites)

Urban Village	Total Sites
Ballard	1
Belltown	1
Bitter Lake	1
Capitol Hill	9
Central District	3
Columbia City	1
Eastlake	2
Green Lake	3
Greenwood	1
International District	2
Lake City	2
Madison/Miller	1
Madrona	2
Magnolia	3
MLK	3
North Rainier	2
Phinney Ridge	1
Queen Anne	2
Rainier Beach	2
Roosevelt	2
University District	3
Uptown	4
Wallingford	3
West Seattle Junction	4
West Seattle Alki	1
West Seattle Morgan Junction	1

## Seattle Green Factor Scorecard Results

### Parcel Size

The parcel size of new development in neighborhood commercial districts varies significantly. The smallest parcel of 5,850 square feet is located in the West Seattle Junction, and the largest is 440,444 square feet located in the International District. The total of these 42 parcels equals 1,339,373 square feet (31.89 acres) as shown in Figure 12.

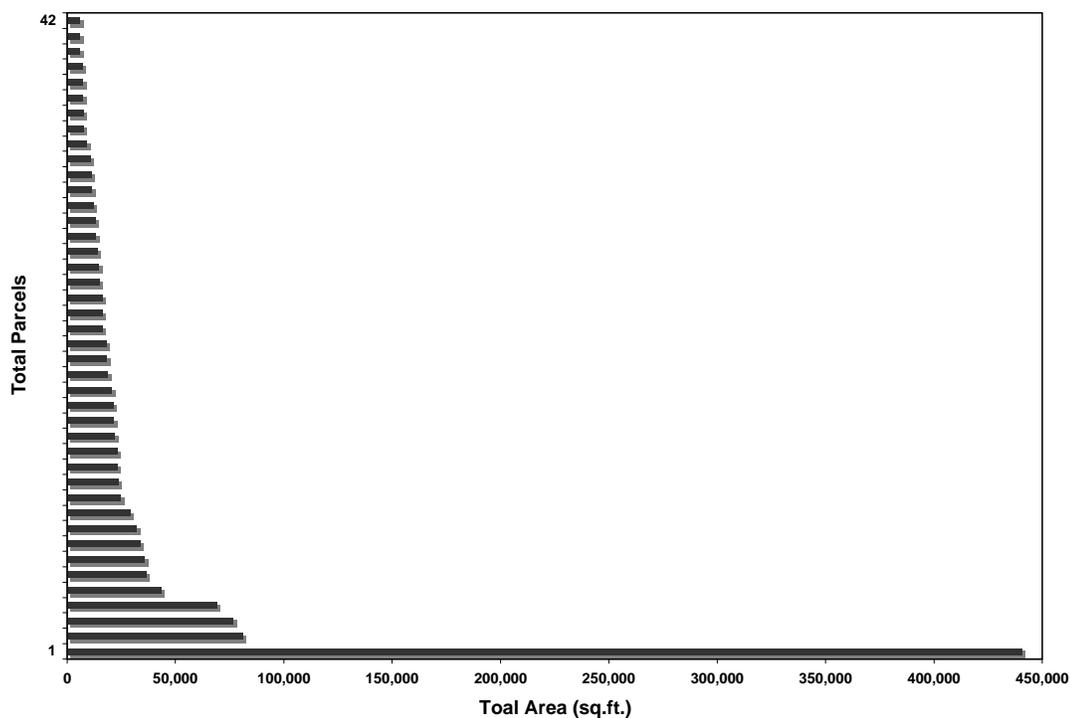


Figure 12. Total Area of Seattle Green Factor Parcels (42 sites)

### Seattle Green Factor Scores

Project sites may exceed the minimum score of 0.30 if desired. Of the 42 sites analyzed, the lowest score is 0.225 and the highest 0.429, with an average score of 0.321 (see Figure 13). This low score was the result of a departure request from a developer to provide only 75% of the SGF requirement.

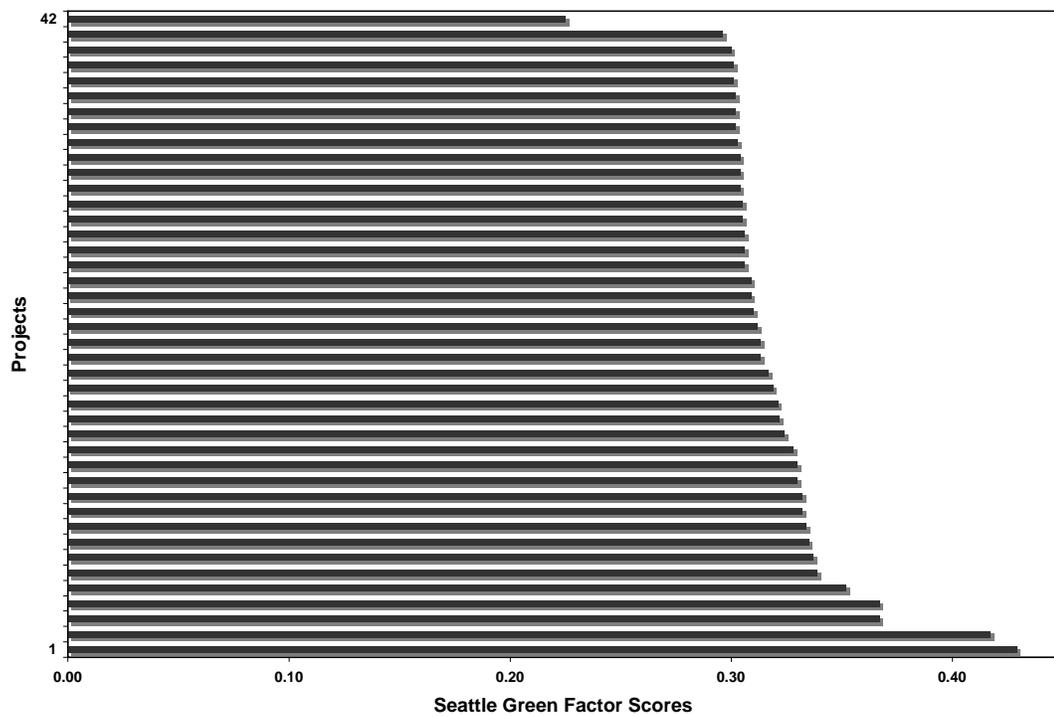


Figure 13. Seattle Green Factor Worksheet Scores (42 sites)

### Frequency of Chosen Elements in Relation to Factor

There is no requirement for choosing a minimum number of SGF elements, which reflects the aim of DPD in creating a flexible regulation. The summary of worksheet data for frequency of chosen SGF elements is shown below in Figure 14. Several of the most chosen elements have a high factor. However, the most selected item, *Visible Landscapes*, has the lowest factor of 0.1. It is not surprising that this is often chosen since it is a bonus that automatically applies to any project with street trees or planting strips. The second most selected element, *Lawn, Ground Cover (>24" soil)*, has the highest factor of 0.7. The inexpensive installation of this particular element makes it a cost-effective item.

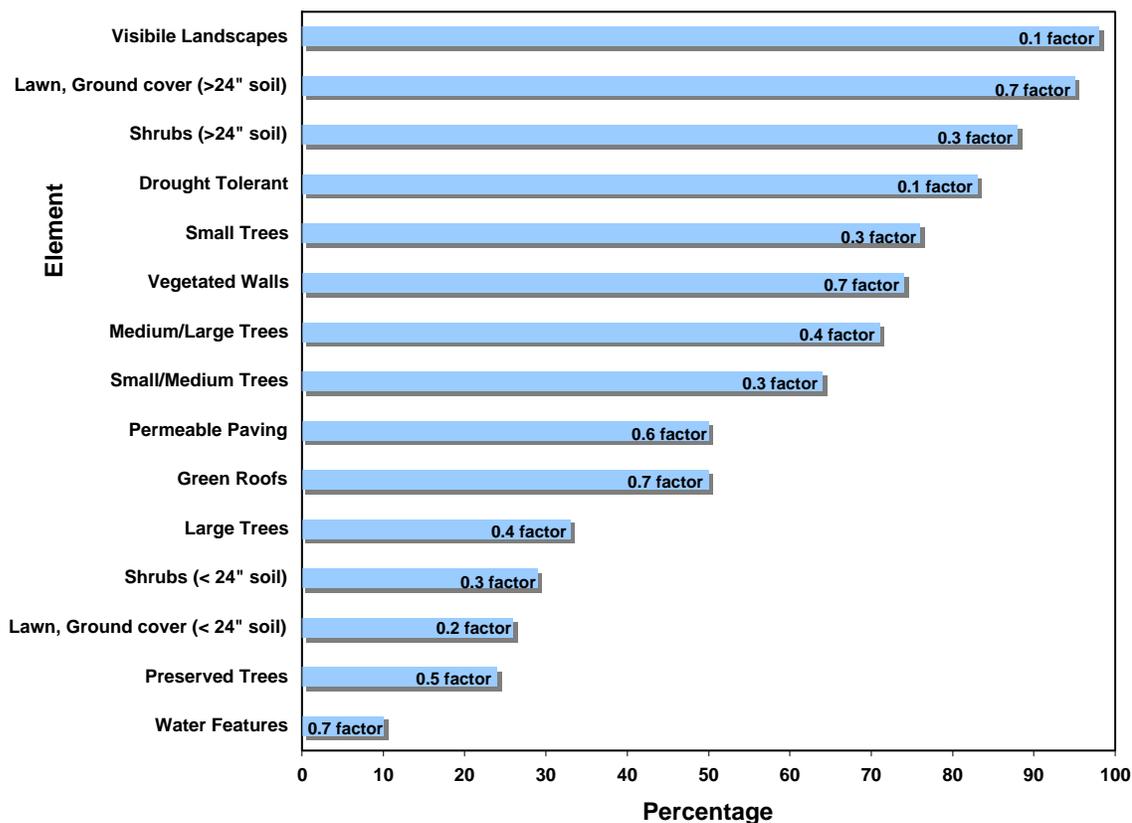


Figure 14. Frequency of Chosen Seattle Green Factor Elements (42 sites)

### Proportion of Seattle Green Factor Elements by Area

As explained previously, a minimum score of 0.30 (30%) in vegetation or pervious surfaces of the parcel's total area is required for all sites. This score is the sum of all landscape areas multiplied by their assigned factors, and divided by the lot size. Square footage data of all the SGF elements was totaled for the 42 worksheets (see Figure 15). For the complete list of selected SGF elements, see Appendix B.

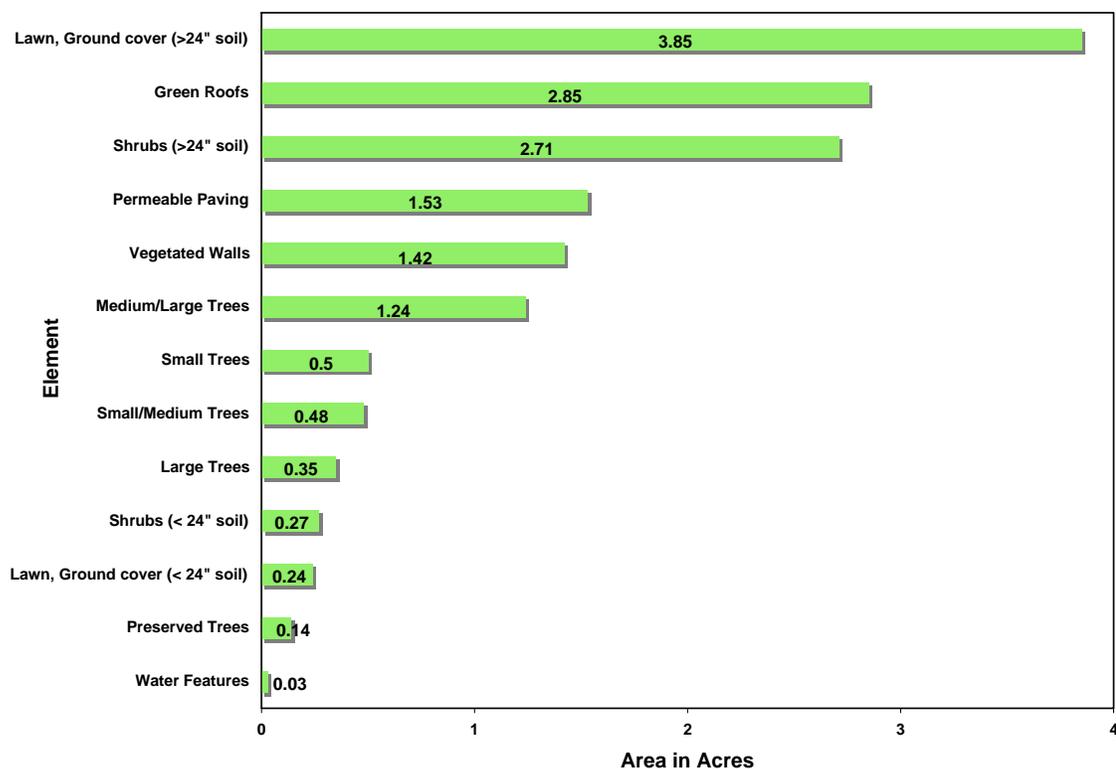


Figure 15. Total Area of Seattle Green Factor Elements (42 sites)

The total Green Factor area of the 42 parcels that must adhere to the requirements of the regulation, and for which scorecards were obtained, is 679,360 square feet (15.60 acres). This number does not include the square footage of bonus elements, which would result in double counting of the area. The total of 15.60 acres is approximately half of the total area of the 42 parcels - 30.74 acres. It is important to note that it does not indicate net change of vegetation, since it doesn't include loss of tree canopy caused by new developments.

The largest quantity, *Lawn, Groundcover (>24" soil)*, equals 167,609 square feet (3.85 acres). This SGF element is chosen 95.1% of the time. The lowest quantity, *Water Features*, 1, 238 square feet (0.03 acres), correlates with the least chosen SGF element. This suggests a direct correlation between frequency of selection and area. Green roofs and permeable paving are only selected approximately 50% of the time, yet these SGF elements occupy some of the largest areas, 2.85 and 1.53 acres respectively. The number of new trees that will contribute to the City of Seattle urban forest total tree stock equals 1,100 (2.57 acres). This amount does not include the preservation of existing trees, 29 trees (0.14 acres).

These SGF area totals are shown by proportion among all parcels in Figure 16 on the following page. To calculate these proportions, the total square footage for all elements was divided into the total Seattle Green Factor area of all projects. The *Lawn, Ground Cover (>24" soil depth)* element is the highest proportion, and the *Water Features* element is the lowest proportion of the total area.

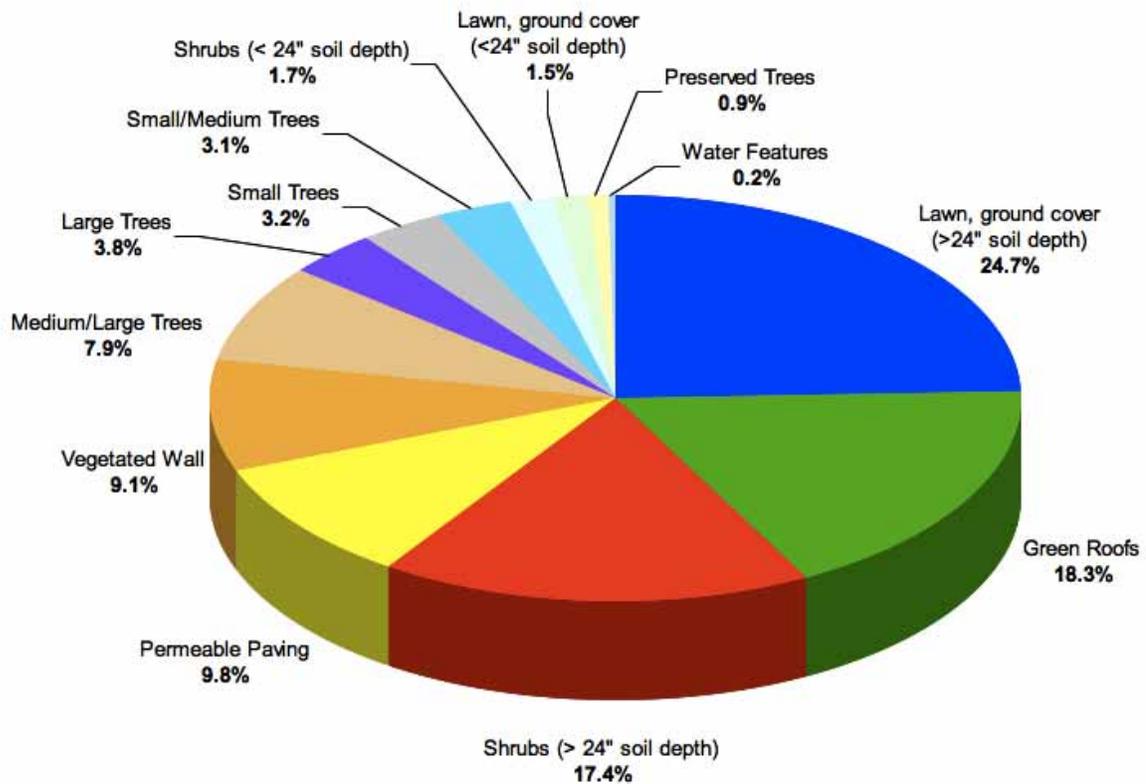


Figure 16. Proportion by Area of Seattle Green Factor Elements (42 sites) (January '07-April '08)

### Total Street Frontage for Seattle Green Factor Sites

Points can be gained by planting street trees, shrubs, and ground covers that face the street. Bonus points for landscape visible to passers-by also count toward the total required score. Therefore, the number of sides of street or alley frontage can make a difference in meeting the SGF requirements. One interview respondent commented that, "Certain sites are difficult to meet the Seattle Green Factor. The math is very difficult without corner street frontage." Of the 42 sites analyzed, 81% of the

located site plans, showed locations of streets and alleys. Of this sample, only four sites have 4-sides of street or alley frontage. The majority of sites have 2 to 3-sides of street or alley frontage. Only one site has 1-side of street frontage (see Table 7). Most sites have at least two sides of street frontage. This is important to note since it is a possible area for which to receive points.

Table 7. Street and Alley Frontage Totals

<b>Type</b>	<b>Total Frontages</b>
Street frontage (1)	1
Street frontage (1) + Alley (1)	7
Street frontage (2)	9
Street frontage (2) + Alley (1)	9
Street frontage (3)	4
Street frontage (3) + Alley (1)	1
Street frontage (4)	3

### **Street Frontage Comparison**

It can be difficult to achieve the SGF minimum requirements for a mid-block location without installing a green roof, or setting back the building. The difference between a corner lot and mid-block location is illustrated on the following pages (see Figures 17 and 18). Both buildings have equal square footages, however the mid-block building only has one side of street frontage. The corner lot achieved a score of 0.30 by selecting green walls and street frontage plantings. The mid-block site, with one side of street frontage, achieved a score of 0.30 by selecting a green roof in addition to street frontage plantings and green walls.

**Corner Lot Development**

- ⇒ SGF score 0.30
- ⇒ 5,400 square feet
- ⇒ 2 sides of street frontage

**F** Drought Tolerant Plants = 550 ft<sup>2</sup>

**G** Visible Landscape = 2,222 ft<sup>2</sup>



Figure 17. Seattle Green Factor, Corner Development

### Mid-Block Lot Development

- ⇒ SGF score 0.30
- ⇒ 5,400 square feet
- ⇒ 1 side of street frontage

**G** Visible Landscape = 984 ft<sup>2</sup>

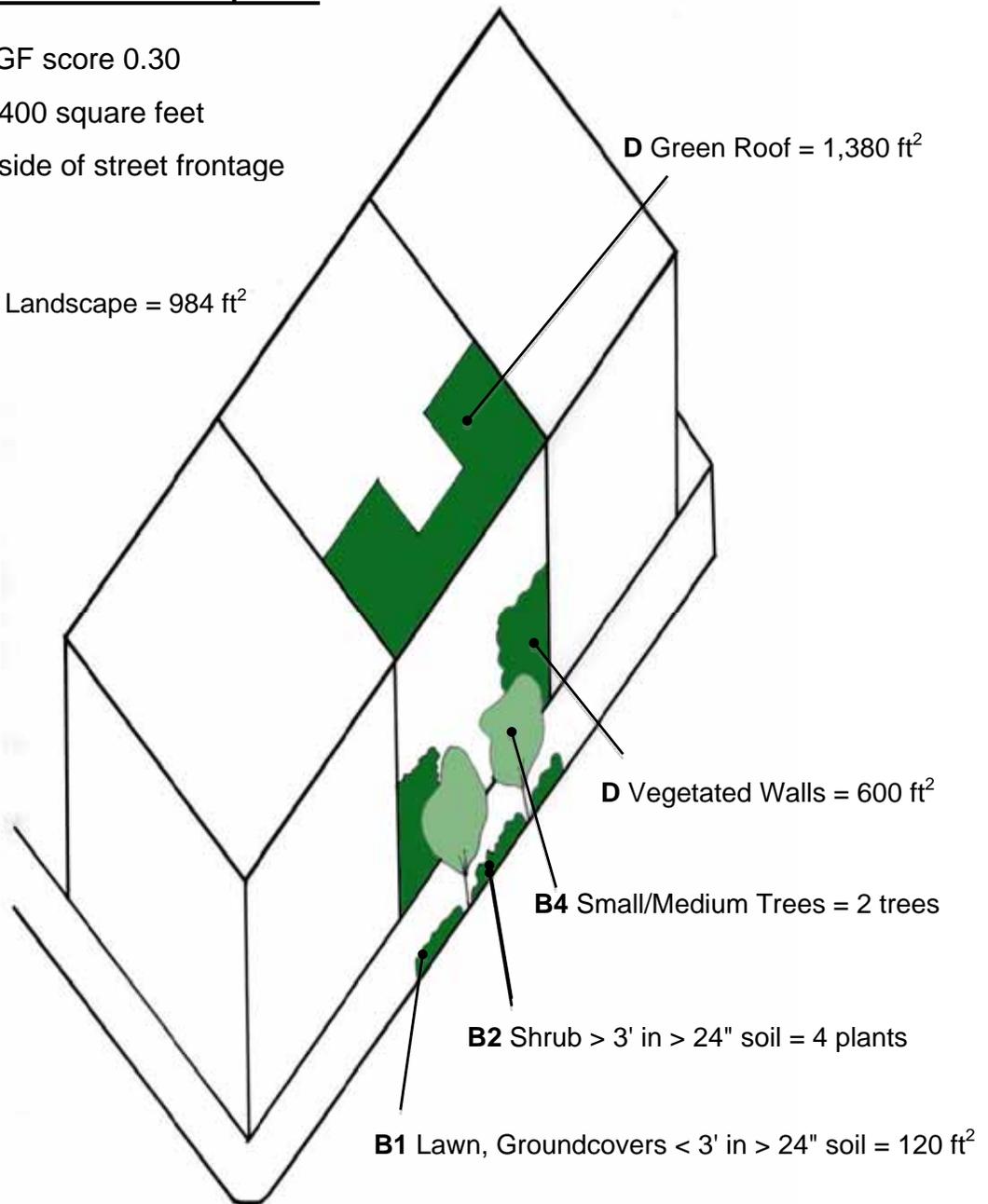


Figure 18. Seattle Green Factor, Mid-Block Development

**Further Study**

The cost of each SGF element was not analyzed in this study since preliminary research revealed a wide spectrum of costs. Further research for the cost of each landscape element may indicate to what degree cost dictates selection of SGF elements. It was noted in interviews that cost estimates are often determined after issuance of the construction permit. Many professionals did not have this data readily available. Additionally, some developers of large projects say that the landscape installation is a small fraction of the total cost of the project. A study of the cost of built landscapes per project as a percentage of total development cost would be useful for future expansion of the code.

This research indicates overall trends in which elements are chosen and in what quantity. Data from interviews from the development and design professions, presented in Chapter 6, further explain why certain elements were chosen.

## **CHAPTER 6 – Findings from Interviews**

This chapter presents results from city staff interviews and professional designer and developer interviews. Findings from submitted Seattle Green Factor worksheets and interview responses form the basis of the conclusions and recommendations presented in Chapter 7.

### **City Staff Interviews**

Speaking with City of Seattle permit-review staff aided in understanding the review process for Master Use Permits (MUPs). Seattle Department of Planning and Development (DPD) first review all permits. Specifically, a team made up of approximately 20 DPD permit staff review commercial development permits. This team is responsible for reviewing all SGF requirements. Next, Seattle Department of Transportation (SDOT) reviews right-of-way plantings submitted in the MUP. Development sites are required to plant street trees in most cases. Finally, Seattle Public Utilities (SPU) reviews for drainage and stormwater retention requirements. Once reviewed by SDOT and SPU, permits are returned to DPD with comments. DPD is responsible for granting final approval.<sup>73</sup>

For this research, interviews were conducted with three City of Seattle employees: two from DPD, and one from SDOT. Questions were designed to: determine the difference from the old code in terms of complexity and processing time, ask for suggestions for improvement, and consider the potential for expansion to other

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<sup>73</sup> Seattle Department of Transportation permit reviewer, interviewed by author, Seattle, WA, March 12, 2008.

zones. (See Appendix C for the complete list of questions.) During each interview, responses were transcribed without the use of audio. Therefore, responses are not recorded verbatim, but as close to the actual response as possible. For accuracy, all interview notes were typed and sent back to each interviewee for approval. (See Appendix D for all interview responses.)

## **Results**

In general, DPD permit reviewers feel that the Seattle Green Factor is a positive step and an improvement of the old code. One respondent commented, “This is a really creative approach to help restore ecological function in the City. Before the Seattle Green Factor, the requirements were awful, almost nothing.” A common concern among all respondents is for a higher level of coordination between departments in order to issue permits during the permit review process.

SGF is fairly straightforward from the perspective of permit reviewers. Usually, the MUP application requires corrections regarding specific SGF elements. For the most part though, the worksheets and landscape plans are sufficiently completed. Many of the questions from applicants pertain to specific definitions regarding SGF elements. For instance, some applicants want to add permeable pavement in the right-of-way. However, at the time of this research, permeable paving was and still is not allowed by SDOT in the right-of-way. There are also some applicants, who call DPD to say that they cannot meet the requirement of 0.30 owing to

a lack of street frontage. In these cases, permit reviewers help the applicant find ways to meet the requirements.

The permit review staff suggested that aspects of the Seattle Green Factor, which are restrictive, unclear, or difficult to implement, could be revised. Two examples of this are: restrictions around permeable pavement in the right-of-way and the definition of water features. Many applicants would like permeable pavement to be allowed in the right-of-way. Additionally, one respondent was unclear why credit can be achieved for installing fountains when there is no requirement that this water must be recycled. Another suggested a revision to the code that would not allow the installation of green walls on the lot line facing abutting properties. If an adjacent property is built out in the future, the result may be that the vegetated wall would be destroyed or taken down.

Respondents also offered specific suggestions for revisions to the SGF worksheet. They suggested clarifying the credit regarding visibility, giving less credit for grass and groundcovers planted in greater than 24 inches of soil, and giving more credit for planting trees. Additional elements for a revised SGF worksheet could include giving a value to sites that integrate all credits, incorporate vegetable gardens, and use native plants.

It is recommended by some to expand the Seattle Green Factor to multi-family zones, industrial zones, and even consider expansion to all zones. One respondent commented, “Yes, expand the Seattle Green Factor to all of them. It can work in all land uses, even industrial lands. People want both industry and habitat restoration.

Our industrial lands are 100% paved. Industrial lands are a lost opportunity.”

However, it was noted that precaution should be taken applying SGF to industrial lands in order to preserve industry in the City.

Several comments made at the end of the interviews did not pertain to specific questions. According to one permit reviewer, some applicants submitted plans with tree pits overcrowded with small plants in order to get maximum points in the right-of-way. Some respondents feel that the additional vegetation will increase the need for irrigation due to the requirements of the SGF. Most importantly, an enforcement protocol needs to be created for the maintenance of the SGF sites. Despite these concerns and suggestions for improvement, the interviewed permit review staff generally support the Seattle Green Factor.

## **Designer and Developer Interviews**

Interviews were conducted with professionals from the development, architecture, and landscape architecture professions. They provided important insights regarding the intricacies and complexities of the Seattle Green Factor. (See Appendix E for a full list of questions and Appendix F for all responses from individual interviewees.) Many suggestions were offered to improve the Seattle Green Factor that did not fit into any of the category of questions. Feedback was offered after the formal interview, or noted throughout the interview. Responses helped explain why certain landscape elements are chosen, what is working with the regulation, and which areas need improvement.

## **Green Profile of Firms**

The Seattle Green Factor was adopted in a city with a building industry experienced in sustainable design practices. The majority of the firms represented by those interviewed have experience with green design and several firms have LEED accredited designers. Many firms have portfolios of LEED, Built Green<sup>®</sup>, or sustainable buildings. One respondent commented that he has experience with green design even though his firm does not.

## **General Opinion**

The Seattle Green Factor is generally viewed as a positive improvement from the old code. According to one respondent, the Seattle Green Factor is much more

flexible than the former open-space requirement, which was often vague, annoying, and always included an exception. Another respondent remarked that the minimum score could be set higher than 30%. Those in favor of the Seattle Green Factor feel that the concept further promotes ecological function in the city and adds value or amenity to a project.

While the majority of those interviewed view the regulation as positive, several spoke of the downsides. The Seattle Green Factor is viewed by one respondent as “just one more layer of bureaucracy” amidst an already challenging permitting process. It is too restrictive and quantitative, reducing the designer to an accountant. While the Seattle Green Factor is based on quantifying landscape elements, one interviewee suggested making the regulation more qualitative and less quantitative. Additionally, concerns include clarification of certain landscape elements, limited light created by the required density of plantings, and public access to the courtyard landscapes. Moreover, due to higher costs of landscape design, the Seattle Green Factor could have the effect of lessening affordable housing, especially for smaller developments. The concern mentioned repeatedly is that there needs to be better coordination between the different city departments.

### **Influence of Cost**

For some, cost influences the choice of which SGF landscape elements to pursue or exclude. Six of the interviewees said that cost was not an issue. For one interviewee, the cost became more of an issue after the initial design phase when

construction costs were worked out. It was also recognized that total costs are often unknown for many of the green roof and green wall systems. Two others commented that the landscape becomes expensive when built on a structure as opposed to installed in the ground. Five different interviewees felt that cost is always an issue. In particular, green walls, green roofs, and water features tend to be the most costly. It was mentioned by one interviewee that SGF costs go down with every floor you go to the height of around 75'. Above that height, additional building restrictions add costs associated with earthquake and fire code. This interviewee concluded that 65' is the ideal height for a development to "pencil-out" and meet SGF requirements.

### **Suggestions for Changes to Seattle Green Factor**

The Seattle Green Factor is regarded by most as straightforward, however several respondents felt that the details and instructions can be confusing and complicated. It should be noted that when asked how to revise the SGF; five respondents either had no response or felt that change was unnecessary. Others offered several suggestions for improvement, such as changes to the code and the worksheet itself. The following sections summarize these responses. Table 8 (p. 68) lists the suggested changes and corresponding number of responses.

Table 8. Factors to Change of Seattle Green Factor Elements

<b>Suggested Change</b>	<b>Number of Respondents</b>
<b>Lower</b> factor for <b>lawn</b>	3
<b>Lower</b> factor for <b>vegetative walls</b>	2
<b>Lower</b> factor for <b>large plants</b>	1
<b>Lower</b> factor of <b>water feature</b>	1
<b>Higher</b> factor for <b>trees</b>	3
<b>Higher</b> factor for <b>visibility</b>	2
<b>Higher</b> factor for <b>drought tolerant plants</b>	2
<b>Higher</b> factor for <b>plants and shrubs over 3'</b>	2

No interviewee suggested removing any element from the SGF worksheet.

However, it was thought that some elements should be defined differently. Four interviewees offered no response. A summary of individual landscape elements to be defined differently is listed below in Table 9.

Table 9. Clarification to Seattle Green Factor Worksheet

<b>Suggestion for Clarification</b>	<b>Number of Respondents</b>
Specify recycled water for water features	1
Clarify definition or reason to include lawns	1
Reduce depth of soil on roofs from 4"	1
Specify a minimum dimension for green roofs	1
Reduce height of green walls from 30' to 15'	1
Assign different point systems for various green wall systems	1

Interviewees had many suggestions for adding additional landscape elements and options for receiving bonus points. Five respondents did not have any suggestions for additional elements. Table 10 lists the suggested changes and corresponding number of responses.

Table 10. Additional Elements for the Seattle Green Factor

<b>Addition</b>	<b>Number of Respondents</b>
Native plants	1
Sidewalk cafes	1
Rainwater irrigation	1
Outdoor art	1
No net loss of tree canopy	1
Alternative power for landscape maintenance (e.g. solar)	1
Permeable pavement, which does not only drain onto itself	1
Higher factor for placing vegetation on building vs. ROW	1
Higher factor for anything on structure	1

### **Structural Changes to Buildings**

All those interviewed, who incorporated a green roof into their design, had to make necessary structural changes to accommodate the extra weight of the roof. If the roof is larger and the building taller, then more significant structure will be necessary for both wood or steel frame buildings. If a client plans to build a green roof from the onset, then the added structural elements are incorporated into the design. At that point, it is important for the landscape architect to communicate clearly at that point with the structural engineer about any potential concerns. Some clients do not want to

deal with the perceived maintenance problems of a green roof. A waterproofing consultant should always be part of the design team regardless of the type of roof.

### **Effect on Insurance from Seattle Green Factor**

Few interviewed were able to comment on whether any of these landscape elements affect dealings with insurance agents. Vegetated walls and green roofs may pose concern, but according to one interviewee, high quality products, the presence of a waterproofing consultant, and the requirements of the Seattle Green Factor should alleviate any difficulties with insurance agents.

### **Minimum Score**

In most cases, the designer will stick to the minimum score of 0.30. Based on the results from the tabulated SGF worksheets, the average score is 0.321. Scores may be higher than reported since most projects stop calculating after reaching 0.30. Upon completion of a landscape installation, more landscape features may be installed. There is no reason to go over the required amount unless vegetation and pervious surface were always part of the design. One designer commented, “We have gone over because it was what the client wanted. However, we are getting in the mindset of sticking to 0.30 because the client may be concerned with cost.” In one case, a score exceeded 0.40 in an effort to compromise with one single-family neighborhood resistant to added density and building height.

### **Incorporation of New Seattle Green Factor Elements**

Half of those interviewed confirmed that they had used all of the SGF elements before. It was mentioned that now there will be greater density of vegetation designed into sites and in the right-of-way. It was acknowledged that now there is more emphasis on green walls and green roofs, and that these elements are new for some.

### **Expansion Seattle Green Factor to Other Lands Uses**

When asked if the regulation should be expanded to other land uses, there was a wide range of viewpoints. One interviewee cautioned not to expand the regulation without a 5-6 year evaluation period. Table 11 summarizes the suggested expansion of the SGF into various land uses zones.

Table 11. Expansion of Seattle Green Factor to Other Land Uses

<b>Other Land Uses</b>	<b>Number of Respondents</b>
Multi-family: Yes	2
Multi-family: No	2
Single-family: Yes	3
Single-family: No	4
Industrial: Yes	3
Pay parking lots downtown: Yes	1
Publicly owned land: Yes	1
Downtown commercial high-rise (lower factor): Yes	1
Downtown commercial high-rise: No	1
All zones	3

### **Role of the Landscape Architect**

Architects, landscape architects, and developers are in agreement that the Seattle Green Factor brings the landscape architect into the design process at the beginning stages. For most, the landscape architect is often part of the team from the beginning. The Seattle Green Factor design time may add substantial costs for a project. In one case, a landscape architect was not used on a project because the developer did not want to pay the added cost. According to him, DPD did not require that a landscape architect design the plans. It was also noted that it is important for a civil engineer to be included at the beginning. Another observation was that architecture firms with in-house landscape architects have the added advantage of being able to coordinate changes throughout the design process.

### **Summary**

The responses from interviews provided valuable information about how the Seattle Green Factor is being implemented and perceived. The majority of respondents are in favor of the regulation and it is perceived as an improvement of the old code. One of the main concerns is the need for better coordination between city departments. In order to help DPD make future revisions and improvements to the Seattle Green Factor, my final recommendations are presented in the following chapter.

## **CHAPTER 7– Conclusions**

The Seattle Green Factor provides an innovative way of increasing vegetation and pervious surfaces in an urban environment. Over time the new requirements will add a significant amount of green infrastructure to the city. In the 14 months since the adoption of the code, an additional 15 acres of vegetation and pervious surfaces have been planned for 30 acres of new development. Of that total, 1,100 trees and 2.57 acres of trees canopy will be added to Seattle’s urban forest.

In the fall of 2008, DPD will present revised changes of SGF to the Seattle City Council. Also, the planning (DPD), transportation (SDOT), and utility (SPU) departments are in the process of examining ways to streamline the permit processing for projects needing approval from several departments.<sup>74</sup> The results from analysis of SGF worksheets and feedback from interviews provide guidance for recommended changes to improve the code. These changes will not be drastic, but will help provide more definition and options for meeting the goal of increasing green infrastructure in Seattle as it increases in density.

### **SUMMARY OF WORKSHEET DATA AND INTERVIEW RESPONSES**

#### **Most Selected**

Receiving a bonus for designing visible landscapes and using drought tolerant plants are easy ways to receive additional points, so it is not surprising that these

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<sup>74</sup> Seattle Department of Planning and Development permit reviewer, interviewed by author, Seattle, WA, March 12, 2008.

options are often selected. With a high factor of 0.7 and low cost in design and installation, it is clear why *Lawn and Groundcovers Planted in greater than 24” of Soil* ranks as the second most selected. While trees are featured in many designs, the most selected are the small trees, which are less expensive and occupy less space.

### **Least Selected**

As noted throughout the interviews, *Water Features* are not chosen because of higher cost, maintenance, and consumption of water. While the preservation of large trees is selected infrequently, some may argue that more trees will be preserved as a result of the Seattle Green Factor. By simply planting in soil greater than 24”, a higher factor can be achieved. This is the primary reason why few select *Lawn and Groundcover Planted in less than 24” of Soil* and *Shrubs Planted in less than 24” of Soil*. While both *Green Roofs* and *Permeable Paving* are roughly chosen only half the time, these features still occupy a large portion of proposed SGF landscaped area.

### **Area of Seattle Green Factor Elements**

The second most selected element *Lawn and Groundcover Planted in greater than 24” of Soil* has the highest amount of square footage at 3.85 acres. Additionally, *Shrubs Planted in greater than 24” of Soil*, are planned for 2.71 acres. While *Green Roofs*, *Permeable Pavement*, and *Vegetated Walls* are not chosen as often, they occupy some of the largest areas of 2.85 acres, 1.53 acres, and 1.42 acres, respectively. The largest area of tree canopy is for the *Medium/Large Trees* at 1.24 acres even though

these trees are selected less often than smaller trees. Only 0.14 acres are planned for *Preserved Trees*. It's worth noting that there is no method for tracking vegetation loss due to new construction.

## **RECOMMENDATIONS**

### **1) Changes to Factor Numbers**

While some of the suggestions made by interview respondents are recommended others are not. This is based on feasibility and the purpose of the SGF. For instance, there was a suggestion to raise the factor for visible landscapes. This is unnecessary as 99% of the projects choose this bonus point. Another suggestion was made to give a higher factor to anything on a structure or a building since these landscape installations tend to be the most expensive. Structured landscapes are usually vegetative walls and green roofs, and assigned a high factor of 0.7. Lowering weights for larger plants seems counter to the city's goal of providing more green infrastructure, but was suggested owing to a concern of designing dark spaces with too much perceived vegetation.

Based on suggestions made by interviewees and the intended goals of the SGF, I propose changing several of the factor points. As previously noted, one of the most frequently chosen elements is *Lawn, Groundcover Planted in greater than 24" of Soil*. However, these landscape features are regarded as having less ecological function than others, such as trees. Therefore, a higher factor for *Preserved Trees* and lower factor for *Lawn, Groundcover Planted in greater than 24" of Soil* is recommended. This

would contribute to the city's goal of increasing the urban forest. Another frequently chosen element is vegetative walls. While vegetative walls have ecological function, there is concern that they will not be properly maintained. The factor for *Water Features* should also be lowered since it is not specified that water must be recycled. Finally, the observation was made that the SGF may have the adverse effect of increasing water consumption in Seattle. Raising the point factor for *Drought Tolerant Plants* would promote their use and help counter excessive water use. Any of these suggested changes to the SGF worksheet would have an impact on future landscapes and buildings. Therefore, further examination into the specific factor changes would need to be determined by DPD.

#### Recommended Changes to Factors

**Lower** factor for **lawn**

**Lower** factor for **vegetative walls**

**Lower** factor for **water features**

**Higher** factor for **trees**

**Higher** factor for **drought tolerant plants**

#### **2) Changes to SGF Worksheet Wording**

Several suggestions were made to define elements differently. Many appear worth consideration with the exception of applying different point systems to various green wall technologies. Since technologies continue to change, this would be a

complex system to track. For instance, several companies sell green wall and roof systems, and permeable paving options for different prices and qualities.

The idea of applying a different factor based on lot size or amount of street frontage for landscapes is worth further investigation by DPD. Parcels that occupy corners or entire blocks may have an advantage over parcels in the middle of a block.

The following clarifications are recommended:

#### Recommended Changes to Factors

- Specify recycled water for water features.
- Clarify the definition or reason to include lawns. Many respondents do not understand the reason for a high factor for lawn/groundcover planted in greater than 24 inches of soil.
- Reduce the 4 inch depth of soil on roofs to encourage installation of green roofs.
- Specify a minimum horizontal dimension for green roofs to avoid small patches of green roof installation.

### **3) Additional Elements to Include on SGF Worksheet**

There is concern that the Seattle Green Factor is only one more layer of permit complexity. Adding additional elements to the worksheet may increase confusion and add to design time. Aside from this concern, a variety of creative ways for receiving credit were suggested that would add flexibility to the regulation. Of those mentioned, I recommend including native plants and specifying the use of rainwater irrigation to aid in water conservation. Receiving points for no net loss of tree canopy would help preserve existing trees. The use of alternative power in landscapes, such as water

pumps or lighting powered by solar technology, would help reduce the energy costs of landscapes.

#### Recommended Additions to SGF Worksheet

- Native plants
- Rainwater irrigation
- No net loss of tree canopy
- Alternative power for landscape maintenance (e.g. solar)

Several of these suggestions are included in the proposed revisions to the Seattle Green Factor. DPD is currently in the process of revising the worksheet and requesting the updated version to be approved by Seattle City Council, anticipated to go into effect in early 2009 (see Appendix G).

In addition to specific recommendations to the worksheet, additional changes were recommended by respondents throughout the interviews to improve the Seattle Green Factor. Several of these ideas have been taken into consideration for this summary. The following recommendations for improvement to the Seattle Green Factor are explained below.

#### **4) Programmatic Improvements**

**Website:** The SGF website provides history, overall goals, images, and forms for permit applicants, see <http://www.seattle.gov/dpd/Permits/GreenFactor>. The addition of photos would help clarify specific landscape elements. For example, there are many

ways to achieve credit for a green wall growing on a metal structure, attached to the building itself, or growing down from the rooftop. Pictures of all these examples would aid in understanding possible options. A list of constructed buildings with public access would provide assistance to future designers and developers with SGF projects.

**Code compliance:** There are multiple links to information on the website, the worksheet, and embedded within the cells of the worksheet. One link or webpage explaining all the acceptable landscape features would reduce confusion. Ideally, it should be clearly stated which Director's Rules must be followed. The website provides the "Draft Landscape Directors Rule," which has not been officially approved. However, applicants are instructed to this guide instead of the outdated 1992 Director's Rule.

**Workshops:** Workshops were held when the code was adopted to provide explanation and support. Follow up workshops and discussion groups may help designers exchange ideas and share projects. It can be assumed that some landscapes will be installed in the fall of 2008 as several projects near completion. This would be an ideal time to promote the Seattle Green Factor in the commercial maintenance landscape industry by hosting a series of workshops on proper pruning techniques and plant replacement. Thus contributing to the upkeep of landscape installations.

**Project Tracking:** Currently there is no system for tracking developments that must meet the Seattle Green Factor. The list generated from this research will soon be outdated as more permits are submitted, or as projects are cancelled. Considering that Seattle is the first city in the U.S. to implement this policy, other cities will greatly benefit from an ongoing assessment of the program. Highlighting and/or rewarding SGF developments in a yearly awards ceremony or a website may raise enough interest in building owners, tenants, maintenance teams, and the public to further enhance the quality of their landscapes. Winners could receive a display sign stating that their development is a Seattle Green Factor site.

**Maintenance Enforcement:** Without maintenance enforcement, the Seattle Green Factor may lose momentum and applicants may get the sense that meeting the requirements is only a formality. Upon project completion it can be assumed that an inspector would evaluate the landscape before occupancy. However, one interviewee commented that inspectors tend to focus on buildings rather than landscapes, and it is not clear how closely each landscape would be inspected. Therefore, a small team or one individual at DPD charged with evaluating the program yearly and inspecting sites for proper maintenance would greatly enhance the long-term success of the landscapes.

**Incentives:** Incentives could provide a way to create more green infrastructure in the city. A project might receive a certain bonus if their SGF score is significantly above 0.30. Incentives would also make the SGF fair for all property owners. For instance, if a parcel falls below a certain square footage or is situated mid-block, a point reduction

may be triggered to offset high SGF costs. Further study is needed to determine the reasons that certain projects have requested departures from the SGF requirements. The size and location of parcels eligible for incentives would be determined based on such an examination.

**Expansion to Other Land Uses:** The City of Seattle Department of Planning and Development is considering expanding the SGF to other land uses. Currently, the expansion to multi-family housing is under discussion. Many of those interviewed supported the expansion of the code. However, it would be prudent to wait until after seeing the results of several current landscape installations before expanding SGF to other land uses. Setting up a tracking system, and monitoring the built landscapes would allow the City to evaluate the effect of adding vegetation and pervious surfaces.

## **FURTHER STUDY**

Owing to the timing of this research, built landscapes were not included for evaluation. Visits to sites in October 2008, found approximately 12 under construction. Further study of the built landscapes in the form of a formal maintenance and monitoring program is recommended. This would reveal not only the appearance of the built landscapes, but also their reduction of CO<sub>2</sub> emissions, amount of rainwater captured, and effect on building performance. In this way, the yearly contribution to

the city of Seattle's goal of adding 30 acres of new tree canopy within 30 years could be assessed.<sup>75</sup>

University of Washington Master of Landscape Architecture candidate Susie Philipsen provides a study of the ecological benefits of the Seattle Green Factor elements. In her thesis, she explored the hypothetical effectiveness of the Seattle Green Factor in comparison to international and national precedents. Her work also provides recommendations for adjusting the code itself and a draft set of ecological standards for the city of Seattle.<sup>76</sup>

As more new buildings projects attempt LEED certification, it would be useful to compare the requirements of LEED with those of the Seattle Green Factor to determine which system is the most effective in increasing green infrastructure at the parcel level. Drew Gangnes from Magnusson Klemencic Associates has begun such a study, which may help developers determine how to meet requirements under both systems.

The Seattle Green Factor is an attempt to add a substantial amount of green infrastructure in the city over time. It might be assumed that any amount of vegetation provides some type of benefit, but this may not hold true for all people. One interviewee commented, "Greening may limit interaction between people." Are we filling up the civic fabric with a potentially "undesirable" level of landscape improvements?" These questions may be answered with further research into the public perception of open space and behavior of people in open space.

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<sup>75</sup> City of Seattle, *Urban Forest Management Plan* (2007) <http://www.seattle.gov/trees> (accessed October 7, 2008).

<sup>76</sup> Susie Philipsen, "Making the Gray Grid Green: An Evaluation of and Vision for the Future of the Seattle Green Factor" (master's thesis, University of Washington, 2008).

Finally, researching other cities maintenance and enforcement policies may help Seattle DPD to develop a successful monitoring program. Currently, DPD does not have an enforcement policy for the maintenance of SGF built landscapes. City policies from around the U.S. and the world may provide examples for Seattle.

### **Conclusion**

The Seattle Green Factor offers a creative method for adding green infrastructure to the urban environment. This regulation is the first of its kind in the U.S. and should be thoroughly studied and monitored. Throughout the course of this research, city permit reviewers, designers, and developers provided insight into the nuances of the regulation. Despite some genuine concerns, the general response to the Seattle Green Factor is positive. Now is the time to make revisions to the code. In so doing it will secure the success of the Seattle Green Factor and serve as a model for other cities.

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**APPENDIX A: Green Space Factor, Malmö, Sweden<sup>77</sup>**

<b>Type of area</b>	<b>Factor</b>
Vegetation: area where the plant roots have direct contact with deeper soil layers, and water can freely percolate to ground water level.	1
Vegetation: area where the plant roots don't have direct contact with deeper soil layers, for example on top of underground car park. Soil depth less than 800mm.	0.6
Vegetation: area where the plant roots don't have direct contact with deeper soil layers, for example on top of underground car park. Soil depth more than 800mm	0.8
Green roofs, brown roofs, ecoroofs: calculated for the real area covered by plants, not the area of the roof as projected on the ground surface.	0.8
Open water in ponds, trenches and so on: the area should be under water for at least 6 months/year.	1
Non-permeable areas, including the house built on the plot.	0
Stone paved areas, with joints where water can infiltrate	0.2
Semi-permeable areas: sand, gravel, etc.	0.4
Green walls: climbing plants with or without support. The area of a wall that can be expected to be covered by vegetation within five years. Maximum calculated height: 10 meters.	0.7
Trees with a stem girth of more than 35 cm: calculated for the maximum area of 25 m <sup>2</sup> for each tree.	0.4
Shrubs higher than three meters: calculated for the maximum area of 5 m <sup>2</sup> for each shrub	0.2

<sup>77</sup> Annika Kruse, "Green Space Factor used in Western Harbour, Malmö, Sweden" (prepared for the City of Malmö).

**APPENDIX B: Frequency, Area, and Factor of Seattle Green Factor Elements**

<b>Seattle Green Factor Elements</b>	<b>Factor</b>	<b>Frequency</b>	<b>Plants</b>	<b>Sq Ft</b>	<b>Acre</b>
<b>A. Vegetation planted with a soil depth of less than 24"</b>					
<b>A1.</b> Lawn or grass pavers or ground covers	<b>0.2</b>	<b>26.2%</b>		<b>10,280</b>	<b>0.24</b>
<b>A2.</b> Plants and shrubs 3' and higher at maturity	<b>0.3</b>	<b>28.6%</b>	<b>862</b>	<b>11,694</b>	<b>0.27</b>
<b>B. Vegetation planted with a soil depth of more than 24"</b>					
<b>B1.</b> Lawn, grass pavers or other plants less than 3' tall at maturity	<b>0.7</b>	<b>95.2%</b>		<b>167,740</b>	<b>3.85</b>
<b>B2.</b> Shrubs taller than 3' at maturity-calculated at 16 sq ft per plant	<b>0.3</b>	<b>88.1%</b>	<b>7,615</b>	<b>118,094</b>	<b>2.71</b>
<b>B3.</b> Tree canopy for "small trees" in SDOT's Street Tree Planting Schedule (or equivalent canopy spread of 20'-calculated at 100 sq ft per tree)	<b>0.3</b>	<b>76.2%</b>	<b>449</b>	<b>21,600</b>	<b>0.50</b>
<b>B4.</b> Tree canopy for "small/medium trees" in SDOT's Street Tree Planting Schedule (or equivalent canopy spread of 20'-calculated at 100 sq ft per tree)	<b>0.3</b>	<b>64.3%</b>	<b>208</b>	<b>20,800</b>	<b>0.48</b>
<b>B5.</b> Tree canopy for "medium/large trees" in SDOT's Street Tree Planting Schedule (or equivalent canopy spread of 25'-calculated at 150 sq ft per tree)	<b>0.4</b>	<b>71.4%</b>	<b>366</b>	<b>53,850</b>	<b>1.24</b>
<b>B6.</b> Tree canopy for "large trees" in SDOT's Street Tree Planting Schedule (or equivalent canopy spread of 30'-calculated at 200 sq ft per tree)	<b>0.4</b>	<b>33.3%</b>	<b>77</b>	<b>15,400</b>	<b>0.35</b>
<b>B7.</b> Tree canopy for preservation of "exceptional trees" or trees with trunk diameter exceeding 24" at four and one half feet above the ground -calculated at 250 sq ft per tree	<b>0.5</b>	<b>23.8%</b>	<b>29</b>	<b>5,900</b>	<b>0.14</b>
<b>B8.</b> Permeable paving that drains only itself. It must be at grade – calculated per square foot	<b>0.6</b>	<b>50.0%</b>		<b>66,785</b>	<b>1.53</b>
<b>C.</b> Green Roofs -4" minimum soil depth at time of planting	<b>0.7</b>	<b>50.0%</b>		<b>124,102</b>	<b>2.85</b>
<b>D.</b> Vegetated Wall	<b>0.7</b>	<b>73.8%</b>		<b>61,879</b>	<b>1.42</b>
<b>E.</b> Water Features (fountains) or rain gardens (where allowed by SPU)	<b>0.7</b>	<b>9.5%</b>		<b>1,238</b>	<b>0.03</b>
<b>F.</b> Landscaping using drought tolerant plants or where at least 50% of annual irrigation needs are met from non-potable sources (BONUS)	<b>0.1</b>	<b>83.3%</b>		<b>182,707</b>	<b>4.19</b>
<b>G.</b> Landscaping visible to passers-by from adjacent public right-of-way or public open spaces (BONUS)	<b>0.1</b>	<b>97.6%</b>		<b>495,778</b>	<b>11.38</b>

**APPENDIX C: City Staff Interview Questions**

1. What is your general feeling (positive/negative/neutral) about the Seattle Green Factor?
2. In permit applications for Commercial projects, are Seattle Green Factor worksheets accurately completed? Do the designs match the worksheets?
3. What are the most common questions you receive in regards to complying with the Seattle Green Factor?
4. Is the Seattle Green Factor straightforward or is it difficult to interpret the meaning of each landscape element?
5. Are there parts of the Seattle Green Factor that are unclear, restrictive, or difficult to implement? Which would you recommend revising?
6. Are there any additional landscape elements that should be added to the Seattle Green Factor in order for it to contribute more to ecology or aesthetics?
7. Do you recommend expanding this regulation to other land uses? If so, which ones?

## APPENDIX D: City Staff Interview Responses

### **(1) What is your general feeling (positive/negative/neutral) about the Seattle Green Factor?**

This is a really creative approach to help restore ecological function in the city. Before SGF, the requirements were awful, almost nothing.”

SGF is a huge benefit for building owners and occupants.

SGF is long overdue.

Personally, it is great. As a City employee though, it is mixed due to the pressure to review effectively.

### **(2) In permit applications for Commercial projects, are Seattle Green Factor worksheets accurately completed? Do the designs match the worksheets?**

There are almost always corrections required. The pre-submittal stage is a good time when applicants have questions. SGF seems hard, but it is easier than it looks. SGF allows for flexibility in how credits are determined, and some applicants aren't used to this. They struggle with the labeling on the worksheet. Historically, the old requirements required less information.

The SGF worksheet helps people to focus. They can do the math and see immediate results. Most worksheets match the plans, but there are some plans which are inadequate.

### **(3) What are the most common questions you receive in regards to complying with the Seattle Green Factor?**

There aren't many questions. People have the perception that they have to include green walls or green roofs to meet the requirements. DPD is not giving credit for structural soil, which has been a question for some applicants.

Standards are in different places. DPD uses the Director's Rules when reviewing codes, which date back to 1992. There are Draft Director's Rules, but DPD cannot enforce these yet.

DPD receives calls saying that applicants can't meet SGF 0.30.

There are questions about planting in the right-of-way. Ideally the applicant would start with early design guidance with SDOT. The applicant needs to get conceptual approval from SDOT in order to issue MUP. In sum, the biggest issues are (1) right-of-way (2) coordination between DPD and SDOT

Applicants want to know why they can't use permeable pavement in some places. This issue is under discussion in order to resolve.

<b>(4) Is the Seattle Green Factor straightforward or is it difficult to interpret the meaning of each landscape element?</b>
It is straightforward since we are dealing with larger projects and professionals who understand.
It is straightforward, but the resources are in too many places. The detail should be in the spreadsheet, not in the Director's Rules. For instance, permeable paving is only allowed on private property, but this isn't spelled out on the spreadsheet. Overall, the information is there, but it isn't always apparent.
Create some tools to make it easier to understand (e.g. list of acceptable plants).

<b>(5) Are there parts of the Seattle Green Factor that are unclear, restrictive, or difficult to implement? Which would you recommend revising?</b>
Permeable Paving
It is unclear what water feature refers to. Fountains don't work since 50% of the water needs to be recycled.
The visibility credit has lots of holes
Green walls shouldn't be allowed on a property line, since a new building could be constructed and then the green wall would need to be taken out.
There needs to be a better process for coordination with SDOT.
SDOT and Seattle Public Utilities (SPU) should allow for permeable paving in ROW.
Projects should be linked to SPU drainage requirements
Get as much credit for street trees. One SGF credit can be in conflict with another.

<b>(6) Are there any additional landscape elements that should be added to the Seattle Green Factor in order for it to contribute more to ecology or aesthetics?</b>
Additional SGF points for allowing applicants to integrate all the elements from the roof to the ground.
Points allocated for vegetable gardens.
Place emphasis on credit for native over non-native.

**(7) Do you recommend expanding this regulation to other land uses? If so, which ones?**

Expand SGF to multi-family. There may be complaints, but there needs to be trade offs built into the code.

Expand to industrial areas, but DPD should be careful in order to retain industry.

Yes, expand SGF to all of them. It can work in all land uses, even industrial lands. People want both industry and habitat restoration. Our industrial lands are 100% paved. Industrial lands are a lost opportunity.

**Other comments**

Problematic designs: overcrowding the tree pit with lots of small plants in order to get more points.

There is no maintenance enforcement by the City.

SGF requires additional irrigation.

**APPENDIX E: Designer and Developer Interview Questions**

1. In general, what experience does your firm have with sustainable or green design?
2. What is your general feeling (positive/negative/neutral) about the Seattle Green Factor?
3. Is the Seattle Green Factor straightforward or is it difficult to interpret the meaning of each landscape element?
4. Are there parts of the Seattle Green Factor that are unclear, restrictive, or difficult to implement? Which you would recommend revising?
5. To what extent did cost influence your choice of SGF elements to pursue? Which ones were excluded due to cost?
6. Should weights of particular landscape elements be changed? Higher or lower?
7. Should any individual landscape element be defined differently, or be taken off the scorecard if deemed necessary?
8. Are there any additional landscape elements that should be added to the Seattle Green Factor that would contribute to the ecology or aesthetics?
9. If a green roof was chosen in your design, were there any structural changes that needed to be made?
10. Do green roofs/vegetated walls or other Seattle Green Factor elements impact your dealings with insurance agents?
11. If your team chose to increase the overall percentage above 30%, what were the influencing factors?
12. Has the Seattle Green Factor led you to incorporate landscape elements that you hadn't used previously? If so, which ones?
13. Do you recommend expanding this regulation to other land uses? If so, which ones?
14. Has the process of implementing the Seattle Green Factor regulation affected your working relationships with other professionals? In your opinion, does this regulation bring landscape architects further into the design process, allowing more collaboration with developers and architects?

## APPENDIX F: Developers and Designers Interview Responses

<b>(1) In general, what experience does your firm have with sustainable or green design?</b>
Yes, we have experience. We try to promote sustainable design on each project. Several at the firm are LEED accredited.
Green design is part of the firm's ethic. Five years ago it was too expensive, and met resistance from developers. Now with the Seattle Green Factor, green design is part of the discussion.
The firm has very little experience, but I have a lot of experience.
The firm considers green design a priority. The owner addresses this by getting more density on site, and understanding the layout to make the site efficient with less waste.
We design green buildings as much as possible. We typically initiate conversations in the beginning of the design process.
Good amount of green design
We are a new company, but our goal is to do green design/building. We use "transit/oriented" and "green design" on our logo to describe our company.
Our firm's focus is on infill development projects in Madison Corridor-Rainier Valley area. Sustainability is a large focus of our projects (LEED or green design elements).
WE have worked on a moderate amount of projects (schools, mixed-use, infill projects). We have many Seattle Green Factor projects in development.
LEED and other green building projects
Sustainable Design of firm: documented LEED platinum building, Built Green projects, and sustainability is a core value of the firm. Designs are driven by site requirements and for small-efficient spaces. With smaller sized projects though, it's harder to pencil out for 'green'.
Limited, but growing experience.

<b>(2) What is your general feeling (positive/negative/neutral) about the Seattle Green Factor?</b>
Positive. It's good that Seattle had a precedent with the Berlin model. SGF is much more flexible than the current open space requirements, which are vague, annoying, and always have an exception.
Positive about the concept, especially for the profession. There's not much negative. The neutral parts have to do with the administration, and that it is still a regulation.
<ul style="list-style-type: none"> <li>• Positive about the concept, but apprehensive about the potential lack of enforcement of the maintenance.</li> <li>• At some point, the SGF doesn't make sense, and money may be spent more wisely on other "green" improvements (e.g. money to be spent on large green roofs might be better spent on rooftop photo-voltaic "systems").</li> </ul>
General feeling is that it's good. The vegetation may be denser than is expected since large trees may create dark areas. SGF needs a little bit of fine-tuning.
<ul style="list-style-type: none"> <li>• SGF is too quantitative and restrictive</li> <li>• Skeptical about green walls</li> <li>• There should be an emphasis on native plants</li> <li>• This way of approaching design is like accounting</li> <li>• Forced them to go denser in planters, but is this good in the long run? This may impact future plants growth. This also creates a wall for the occupants/users.</li> <li>• More water intensive</li> </ul>
Strict, restrictive, regimented regulation. It's not clear why some elements have certain weights.
Neutral. There are negative aspects for architects and developers. We tend too not rely on regulations, but do this type of work anyway. This is another level of bureaucracy that takes away from actual design time.
Neutral- Upside: helps to drive the market toward green. The Seattle Green Factor adds value to developments. Downside: regulations add to the cost of housing, affects housing affordability
Generally, it is positive. Concerned about the math before it went into effect.
Positive. It's done a lot to help to create healthier urban landscapes.
<ul style="list-style-type: none"> <li>• Positive. In general, it improves the right-of-way</li> <li>• This was sprung on the community.</li> <li>• Worried about the parcel-by-parcel approach</li> <li>• Incredible financial demand for a small project. There should be alternatives for small projects: e.g. fund a small park instead.</li> <li>• SGF is really about solving a math problem, less about design. We still like the SGF because it gives the landscape architect more ammunition. It's just gotten somewhat disconnected from the original intent.</li> <li>• The amount of design time is too much since there is more permitting time</li> </ul>
It should be more intensive than 0.3. There needs to be a drastic change in planning where the land comes first. The ratio should be based on lot size. SGF should be driven by land use, not stylistic.

<b>cont... (2) What is your general feeling (positive/negative/neutral) about the Seattle Green Factor?</b>
I'm all in favor, but the Seattle Green Factor will have the most success if all architects and developers are on board.
Not too much difference with the old code. Meeting the SGF is no big deal. It's just one more layer of bureaucracy.
SGF adds value to the project vs. cleaning the dirt. These types of costs do not add an amenity.
I am not convinced that the SGF is meeting the City's goal. There is a political and practical disconnect.

<b>(3) Is the Seattle Green Factor straightforward or is it difficult to interpret the meaning of each landscape element?</b>
Upon first glance yes, but it's not that straightforward. There's a lot of room for interpretation with green walls. There are some clues, but not all the landscape elements are explicit.
Permeable pavement was confusing at first. We have a new employee who is new to the area, and he did a good job with figuring out the regulation.
It's not hard.
It is straightforward.
It seems opaque to architects because of the spreadsheet.
Easy, but it's not clear that the SGF scorecard should be in the MUP application.
Straightforward. This regulation doesn't land on the list of difficult. The city process itself is difficult. There is a broken bureaucracy.
Mostly straightforward: Sometimes DPD permit review staff isn't able to help with questions.
Difficult. There are many ways to interpret. The Director's Rules are outdated.
SGF is simple and straightforward: only difficult thing is that you now you must design in 3D.
Complicated scorecard
Scorecard is overly complex.
The big idea of giving developers great flexibility is too complicated. In general, the scorecard should be simplified. There are too many options on the scorecard.
Difficult
No response (2)

<b>(4) Are there parts of the Seattle Green Factor which are unclear, restrictive, or difficult to implement? Which would you recommend revising?</b>
<ul style="list-style-type: none"> <li>• Water features are not sustainable and costly, but rain gardens are fine.</li> <li>• There are typos and inconsistencies with the worksheet.</li> <li>• The definition for an exceptional tree is hard to find.</li> <li>• However, it's not restrictive like the old open space requirement.</li> </ul>
<ul style="list-style-type: none"> <li>• There are lots of holes with the green walls. This may be difficult to implement.</li> <li>• Greening may limit interaction between people. Are we filling up the civic fabric with a potentially "undesirable" level of landscape improvements?</li> </ul>
There needs to be more coordination between city departments (SDOT, DPD) and between city regulations (e.g. Land Use Code vs. the relevant Director's Rules).
No
<ul style="list-style-type: none"> <li>• Clarification of green walls</li> <li>• Make the regulation more qualitative and less quantitative</li> </ul>
No
No
<ul style="list-style-type: none"> <li>• It is less difficult after you have gone through the process a few times. With the same project in the office, there might be 3 different scores/approaches. I tend to do the most SGF projects in the office, and I only caught on to the nuances later. At first, I overlooked permeable paving.</li> <li>• It's possible to overlook the visibility and drought tolerant aspects.</li> <li>• Need to read deeper to figure things out. Sometimes it's confusing to find all the rules.</li> </ul>
Make the minimum score higher.
The precise definitions of the elements are open to broad and various interpretations. The process is not always clear.
No response (2)

**(5) To what extent did cost influence your choice of SGF elements to use? Which ones were excluded due to cost?**

We excluded the water feature due to cost of installation and maintenance.

Green roofs are the last things that a developer wants to do. There are two kinds of costs to consider: economic cost and development potential.

There are significant cost issues. We looked at square footage costs of materials, but we don't have a lot of experience with the contracting/labor side of some of these landscape installations. Rents will be higher due to green factor.

Cost did not come up as an issue.

In the beginning stages of the design cost was not a significant issue. At this stage there is a lot of back and forth (design change) due to cost. Only now are we getting into the actual costs.

Cost wasn't an issue. We were already planning to install green roofs.

- We can make the Seattle Green Factor work; but we have to decide what to provide for the tenants. Cost is a big part of the design. On one project, we thought that 1 foot might need to be taken off the building. Removing 1 foot from a 120' wide x 5-story building may end up in \$300,000 lost value of the building.
- The landscape isn't so expensive, but the structure is expensive, and loss of square footage. Yet, it's possible that people might pay more for landscaping.

Cost is absolutely important. Our projects are very difficult to make work due to cost. The shorter the building, the higher the cost of the green factor. The profit margin may end up at zero. Green factor costs go down with every floor you go up, until reaching 75'. At this point then you're in a different place with the building code, and must adhere to earthquake code. Building needs to be steel and concrete. Therefore, NC 65 is ideal. The green factor makes it difficult to build affordable work force or median income housing. Recommendation: incentive to go up 1 floor if project has an entire green roof.

Cost always goes back to the client. At times cost is an influence. I often get the project after the initial decisions have been made, which usually concern opportunity for structured landscapes (e.g. placement of windows for green walls, green roof potential). I think we are getting better at working as a team though. But, each time the architect makes a decision, the landscape changes.

- Typically, clients are cheap. There are no cheap landscaping alternatives, especially for structured landscapes.
- Cost is prohibitive when you go for the maximum landscaping.
- Designers are selecting green walls, but the cost implications are not worked out yet.
- Developers are excited about green trays/green roof blocks on roofs. They are expensive (apx. \$25/sq ft) but this alleviates fear of installing an intensive green roof. The trays weigh a little bit less, and there is less worry about ruining a roof. However, there aren't many installed projects with green trays. (Alley 24)

A green wall is just as expensive as a green roof. With a green wall people get to experience as opposed to a green roof.

SGF is insignificant cost of the project (plants are cheap).

**cont... (5) To what extent did cost influence your choice of which SGF elements to use?  
Which ones were excluded due to cost?**

SGF is not a significant cost (\$50,000 out of a \$25 million dollar budget).

The building was already designed and the permit submitted. We revised after the code was adopted, so we had to adapt to the Seattle Green Factor. There was already a huge courtyard, where we designed most of the plants. A green roof is very expensive to design and build, but that's where you can go if forced to do so.

**(6) Should weights of particular landscape elements be changed? Higher or lower?**

Lawn is too high. Lawn is considered impervious, acting like pavement, once it is established. Grass pavers are fine, but should be in a separate category from lawn.

Trees are undervalued. I thought trees were supposed to be a huge part of the SGF.

- Visibility makes little difference on the scorecard, and should have a higher factor
- Drought tolerant could be higher, since it also starts to address water consumption and inclusion of native plants

- Large plants weighted too high
- Receive higher points if placing vegetation on building vs. the right-of-way

- Drought tolerant is important (revise the weight)
- Lawn is too high.

- Lawn shouldn't be weighted so high. Lawn, grass pavers or other plants less than 3' tall at maturity weighted at 0.7
- Vegetated walls are problematic, few successful examples

Increase weight for shrubs over 3' tall, create more categories for shrubs, or combine taller shrubs with small trees as a category. Many shrubs that grow over 3' function as trees to produce a lot of canopy.

- Plants and shrubs 3' and higher at maturity should be raised above 0.2 factor
- Anything on structure should get a higher factor due to higher cost
- The biomass of a tree is worth a lot, and often the most successful. Raise the factor for new and preserved trees.
- The visibility credit is hard to interpret, and should be a higher factor
- Lower factor for green walls

Larger diameter trees should have a higher weight since a large tree has a larger ecological benefit than a green roof.

Some factor weights should be changed. For instance, trees should have a higher weight.

Water feature may not need to be taken off, just need a lower factor.

Vegetated walls may need to change the weight since there are varied successes.

No response (3)
<b>(7) Should any individual landscape elements be defined differently, or be taken off the scorecard if unnecessary?</b>
The water feature is not sustainable
Water feature may not need to be taken off, just need a lower factor. This needs more thought.
No, but green walls might be problematic. There are some systems, which are more expensive, but may be better. Assign a different point allocation for different systems.
Lawns need more definition.
<ul style="list-style-type: none"> <li>• No need to remove any features, just define differently</li> <li>• Depth of soil on the roof should be less. 4" foot of soil is too much. Give ½ credit for 2 inches. There are other products, such as David Gold's recycled carpet. This contains fertilizer and seeds, which spreads out from a roll. Couldn't this count toward a green roof, using less soil?</li> <li>• Water features: nice aesthetically, but not sustainable. Must specify that water needs to be recycled.</li> </ul>
No
<ul style="list-style-type: none"> <li>• Green roofs should have a minimum dimension. Makes more sense to put a green roof on a big box store.</li> <li>• Permeable paving is tough due to SDOT standards</li> <li>• Water feature shouldn't be on there: it isn't sustainable, only confusing</li> <li>• Green walls should be reduced in height from 25' to 15' (or 1 story). It is hard to get vines out of the ground to grow taller than 8-15'. There are few possible vines. Ivy isn't allowed, so other than ivy a structure is needed to support vines. (e.g. Capitol Hill Library: Nakano)</li> </ul>
Rain Garden/Water Feature. This is power intensive, meaning you need a cistern, pump, filtration, etc.
Permeable pavement in the right-of-way was declined, which is a disconnect.
No response (3)

<b>(8) Are there any additional landscape elements that should be added to the Seattle Green Factor which contribute to the ecology or aesthetics?</b>
<ul style="list-style-type: none"> <li>• Permeable paving should not be limited to that which drains onto itself.</li> <li>• Bonuses for alternative power (wind, solar) if they are used to power the landscape</li> <li>• Bonus for no net loss plus adding a certain percentage of additional tree canopy</li> </ul>
No, nothing to add.
DPD might consider giving explicit credit or a bonus for provision of landscape maintenance cisterns. Such elements would assist with stormwater detention and reduce water consumption.
<ul style="list-style-type: none"> <li>• Art credits in the landscape. Developers usually have a budget for art.</li> </ul>

<ul style="list-style-type: none"> <li>• Credit for rainwater irrigation</li> <li>• Credit for sidewalk cafes</li> </ul>
<b>cont...(8) Are there any additional landscape elements that should be added to the Seattle Green Factor which contribute to the ecology or aesthetics?</b>
Native plants (but at that same time adding more to the scorecard contributes to the complexity)
No
<ul style="list-style-type: none"> <li>• Credit for urban agriculture</li> <li>• Surface, natural drainage solutions</li> </ul>
No
The SGF should be primarily ecologically driven.
Native species not mentioned, but should be reinforced.
It depends on what is the City's goal.
No response (3)

<b>(9) If a green roof was chosen in your design, were there any structural changes that needed to be made?</b>
There are many green roof products that have warranties and great membranes.
Yes, there needed to be structural changes. Waterproofing is a significant issue, especially with lower, stick-framed buildings
<ul style="list-style-type: none"> <li>• Our roof garden was only up 4 stories, but if it had to go up to 5 then there would have been more changes.</li> <li>• This project is wood frame, which is a bit of a challenge.</li> </ul>
The owner did not want a green roof because he had maintenance problems in the past. The roof is the most important waterproofing detail. Even without a green roof, a waterproof consultant will still be part of the team.
Yes, the green roof design has a lot of implications for the structural load. This makes it necessary for the landscape architect to communicate clearly with the structural engineer about these issues.
We were planning to build a green roof from the start. We are structurally limited because there is only concrete on the 1 <sup>st</sup> floor and wood above. This limits green roof soil depth to 12".
A green roof means more cost to the building. If a wood frame construction, more wood needs to be used, or the other option is steel construction. Waterproofing is necessary. We always use a waterproofing consultant.
Yes, we had to beef up the roof structure. If no green roof, then this wouldn't be necessary. The issue with green roofs is that they end up designed around the stair and elevator core, since this is the

main structural element. A better approach would be to receive more credit if 100% of the roof is covered green, even if the soil depth is less. Use a sliding scale based on the soil substrate.

**cont... (9) If a green roof was chosen in your design, were there any structural changes that needed to be made?**

Decisions need to be made early to know if a green roof is possible. There have been times when structural changes were made later to accommodate a green roof.

Once the landscape architect comes on, the structure has already been determined. Larger roofs need structural change. This is an issue for some, not for others.

There is a significant change to the structure. It needs to be stronger. Wood structure is fine for green roofs, but it has to be engineered properly...but not retroactively.

We didn't choose a green roof. A structural change is always needed with a green roof.

**(10) Do green roofs/vegetated walls or other Seattle Green Factor elements impact your dealings with insurance agents?**

- Vegetated walls might be an issue
- If you have the correct materials for a green roof, then there is no issue

There are maintenance issues with attaching vines to buildings. Yet, there are certain benefits to adding vines, which protect building from UV and heat.

Structured landscapes lead to risk, so there needs to be a waterproofing consultant. The landscape architect or architect should be licensed and insured.

Water is the only issue in this climate, so a green roof has the potential to stock up on green roofs.

Root structures may tear membrane. But, no known difficulties with insurance agents.

No response (8)

**(11) If your team chose to increase the overall percentage above 30%, what were the influencing factors?**

This depends on the client. Some just want to get to the 0.30. Sometimes the design exceeds the minimum based on the design goals. It's good to have 0.30 as the goal.

Developers tend to stick to 0.30. If they go above this, then they were planning to do it anyway, for other reasons of our own.

0.30 was the target, so there's no reason to go above this.

We met the minimum score and moved on. For a small project on a tight site it's hard to go heavy with the landscaping and still realize the financial development potential.

Initially we thought that we had lots of 'green', but ended up surprised that we barely made 0.30.

**cont... (11) If your team chose to increase the overall percentage above 30%, what were the influencing factors?**

The required score of 0.30 had no influence. We actually decreased the score, which had originally been higher. We avoided the hassle with the right-of-way plantings by reducing the score and taking out some of the right-of-way plantings. There is a big disconnect with DPD and SDOT.

We have gone over because it was what the client wanted. However, we are getting in the mindset of sticking to 0.30 because the client may be concerned with cost.

Typically, we don't show more than we need to. Stick to the minimum so your design can be more flexible. You don't need to show additional elements in the permit.

This was due to making peace with single-family neighborhood.

No response (2)

We just chose to meet the code from a cost standpoint. We would go over above 30% if there were some other reason that would enhance the site.

**(12) Has the Seattle Green Factor led you to incorporate landscape elements that you hadn't used previously? If so, which ones?**

There is more emphasis on vegetated walls. This used to be very expensive, but the SGF will make this more competitive.

- Green walls
- Green roofs are new to everyone
- Denser right-of-way planting takes more thought and careful consideration

Greater quantity of landscaping in more locations.

Green walls

Our office incorporated all of these elements before.

We used all of these elements before.

- These are all things that we would choose anyway, unless cost is too much of an issue.
- We might do a bigger roof area with less soil

- We used all of these elements before, but now we are probably using more quantity. This is a big change from the old code. We always exceeded the old code, but not to the extent of the Seattle Green Factor.
- We use the Green Screen more than ever because it's an option. We tend to use a combination of all the elements, which in the end produces a nice result. It far exceeds LEED.

Everyone is using more elements, especially green walls. Our firm had experience with structured landscapes.

**cont... (12) Has the Seattle Green Factor caused you to incorporate landscape elements that you hadn't used previously? If so, which ones?**

Green roofs. All of our firm's projects w/in commercial will have green roofs.

No, but it's possible that a site wouldn't have a green roof otherwise.

No response

**(13) Do you recommend expanding this regulation to other land uses? If so, which ones?**

Multi-family: yes

Single-family: yes

- Industrial Uses: Large areas of unnecessarily paved industrial land may contribute to the heat island effect as well as storm water volumes. Large parking lots are also a potential lost opportunity for including enhanced planting to mitigating the heat island effect.
- Single family: difficult to implement
- Pay parking lots downtown (e.g. perimeter buffers would provide a variety of benefits and trees would mitigating the heat island effect).

Any public/city-owned land

- Single family – no
- Downtown Commercial with a lower factor (.15 for example)

Don't expand the SGF until after 5-6 years of evaluating projects. Test it and work out the kinks.

Yes, this could get expanded to every type of development with different factors per land use.

- Expand to industrial because of the harshness of industrial impact.
- No for multi-family and residential

Typically no. It makes sense with single-family, but not in high-rise zones.

Maybe expand to all of them. The single-family zone is problematic since it's possible to reach maximum build out. This leaves no room for open space/landscaping.

Why not all of them?

- Yes, in industrial areas. There is a big bang for green roofs in these areas. There could be an incentive for green roofs in industrial zones.
- Multi-family/residential

Yes, all of them. Vertical farms. Go into more stringency to require more designs from the landscape architect. We are required to have a landscape architect for LEED projects, public projects, and

larger houses. We (architects) love working with them but it's up to the client, therefore it needs to be required. It's still just a checklist, so an architect can only do so much. There should be more incentives.

**cont... (13) Do you recommend expanding this regulation to other land uses? If so, which ones?**

The SGF is too much overhead and regulation for multi-family.

I wouldn't say yes to expand the SGF since typically this means more money spent. Yet, it results in a higher quality project.

No response

**(14) Has the process of implementing the Seattle Green Factor regulation affected your working relationships with other professionals? In your opinion, does the regulation bring landscape architects further into the design process, collaborating more closely with developers and designers?**

We can't get started without the landscape architect. Sometimes the landscape architect is brought into the process after the building is designed (other codes).

The Seattle Green Factor process has changed the role of the landscape architect. Of necessity they now get involved in the design the process right away. The SGF means the landscape architectural discipline is a much more important "player" in the design process and needs to get into the design / permit phase sooner than has been typical.

The landscape architect is significantly more of a player of the team. They are very integrated into the process. Firms with in-house architects and landscape architects may have an advantage.

No since the landscape architect is one of the first professionals involved in the project. They submit drawings for the first MUP application. At the building permit stage though, the landscape architect is often out of the picture.

The landscape architect is usually needed at the beginning. With the SGF, the landscape architect has more work upfront.

Yes, in some circumstances. It's good to have the landscape architect on early in the design stage. It's also good to bring in a civil engineer early. With larger projects, all of these professionals are at the table early.

Yes, it has brought the landscape architect in early to work on the green roof.

They have always been involved in the design process. The SGF is a new element of the design process. It's still the same process, but now we need to consider the SGF requirements. We will start discussing the regulation earlier in the design process with the client.

- Landscape architects are brought in earlier into the mix.
- If a good team: the SGF strengthens the team
- If a weak team: the SGF weakens the team

The developer didn't want to hire a landscape architect so our landscape design was done in-house. This meant that the architect was able to design and submit plans. This may have been overlooked by DPD.

**14) Has the process of implementing the Seattle Green Factor regulation affected your working relationships with other professionals? In your opinion, does the regulation bring landscape architects further into the design process, collaborating more closely with developers and designers?**

Landscape architects take more time and it costs more money. We are collaborating with them more. We always have a landscape architect, but it takes more time due to DPD and SDOT coordination.

No response

#### **Other comments**

- Needs to be an example MUP on the website. It's hard to know what to turn in.
- Rainwater Harvesting Calculator isn't very accurate, which needs to be revised.
- Who's policing this policy? If word gets out that there's no monitoring, then people won't take the regulation as seriously.
- How many trees are being taken away due to development? The Urban Forest Management Plan states that there will be not net loss of canopy.

Projects should be able to receive credits for photovoltaics on the roof or water/storage cistern instead of constructing a green roof.

- Manipulate the SGF based on lot size (less than a certain square footage, i.e. 10,000 sq ft)
- Tax write off in the end if a site falls below a certain size or location (middle of a block)

- SDOT reserves many areas for traffic improvements because some day it might want to widen sidewalks. The reality is that this doesn't often happen.
- There are good examples in other cities of the permit process. DPD would be in charge of regulating the entire review. DPD runs the meeting, inviting other departments, including the developer. The same team is part of the whole process for a development. It's DPD's job to make sure it gets done right. DPD is thus in charge of carry out the City's mission.
- Incentives: Commit to do higher than .40 to get bonuses

**cont... Other comments**

- Increased irrigation needed with these landscapes. It should be written that all these landscapes should have irrigation. Important!
- Need to enforce the maintenance plan
- Need more photos on website
- Incentives for developers to provide access post construction to see green roofs/interior courtyards.
- Track projects on-line
- The end result may be upsetting if landscape architects are not part of the entire process (start to finish)
- ASLA should be included in future conversation for revisions
- We can tell just by looking at a project if it can meet the green factor or not, but we haven't figured out the perfect combination
- Ask more from bigger developments
- Bigger designs can feature interior courtyards, but this is not going to be possible for a smaller project
- The best bang for the buck is in the right-of-way: just step back the development
- Not enough benefit to public
- Green walls will turn into green mesh, since a lot of these walls will fail
- It would be impressive to try to accomplish some of the Seattle Green Factor goals off site
- Demonstration projects: show positive ways to achieve ("Regatta" example)

Certain sites are difficult to meet SGF. Math is very difficult without corner street frontage.

Inspectors don't pay attention to the installed landscape.

- Maintenance: We will hire an outside property management company to oversee maintenance.
- With the Seattle Green Factor, we spend more dollars up-front. On a smaller project this would be a big problem since you need to take on more risk. A developer wants to spend as little money up-front as possible.

- It takes on average 1 year for the MUP, 4-6 months for the building permit, which leads to less affordable housing. There needs to be higher rents to pay back actual cost
- Review process with DPD and SDOT is very challenging. We were caught in the middle.
- What happens if the exact plant species change? How does it get crosschecked? I would just add at the end that it is unclear how the inspection process for the Certification of Occupancy will work.

**APPENDIX G: Seattle Green Factor Worksheet Draft Revisions**

DRAFT REVISIONS 7/30/08		SEATTLE <i>green factor</i>	
Project title:			
Parcel size (enter this value first) *		enter sq ft of parcel 10,000	minimum score 0.30 for commercial, 0.60 for multifamily res. SCORE -
Landscape Elements**	Square Feet	Factor	Total
<b>A Landscaped areas (select one of the following for each area)</b>			
1 Landscaped areas with a soil depth of less than 24"	enter sq ft 0	0.1	-
2 Landscaped areas with a soil depth of 24" or greater	enter sq ft 0	0.6	-
3 Bioretention facilities	enter sq ft 0	1.0	-
<b>B Plantings (credit for plants in landscaped areas from Section A)</b>			
1 Mulch, ground covers, or other plants less than 2' tall at maturity	enter sq ft 0	0.1	-
2 Plants 2' or taller at maturity - calculated at 16 sq ft per plant (typically planted no closer than 18" on center)	enter number of plants 0	0	0.3
3 Tree canopy for "small trees" in SDOT's Street Tree Planting Schedule or equivalent (canopy spread of 15') - calculated at 50 sq ft per tree	enter number of plants 0	0	0.3
4 Tree canopy for "small/medium trees" in Street Tree Planting Schedule or equivalent (canopy spread of 20') - calculated at 100 sq ft per tree	enter number of plants 0	0	0.3
5 Tree canopy for "medium/large trees" in Street Tree Planting Schedule or equivalent (canopy spread of 25') - calculated at 150 sq ft per tree	enter number of plants 0	0	0.4
6 Tree canopy for "large trees" in Street Tree Planting Schedule or equivalent (canopy spread of 30') - calculated at 200 sq ft per tree	enter number of plants 0	0	0.4
7 Tree canopy for preservation of "exceptional trees" or other large existing trees 6"+ diameter - calculated at 15 sq ft per inch DBH	enter inches DBH 0	0	0.8
<b>C Green roofs</b>			
1 Over at least 2" and less than 4" of growth medium	enter sq ft 0	0.4	-
2 Over at least 4" of growth medium	enter sq ft 0	0.7	-
<b>D Vegetated walls</b>			
	enter sq ft 0	0.7	-
<b>E Approved water features</b>			
	enter sq ft 0	0.7	-
<b>F Permeable paving**</b>			
1 Permeable paving over at least 6" and less than 24" of soil or gravel	enter sq ft 0	0.2	-
2 Permeable paving over at least 24" of soil or gravel	enter sq ft 0	0.5	-
<b>G Structural soil systems</b>			
	enter sq ft 0	0.2	-
sub-total of sq ft =		0	
<b>H Bonuses</b>			
1 Drought-tolerant or native plant species	enter sq ft 0	0.1	-
2 Landscaped areas where at least 50% of annual irrigation needs are met through the use of harvested rainwater	enter sq ft 0	0.2	-
3 Landscaping visible to passersby from adjacent public right of way or public open spaces	enter sq ft 0	0.1	-
4 Landscaping in food cultivation	enter sq ft 0	0.1	-
		Green Factor numerator =	-

\* Do not count public rights-of-way in parcel size calculation.

\*\* To calculate your score, you may count landscape elements that are in rights-of-way if they are contiguous with the parcel.

\*\*\* Permeable paving may not qualify for more than one third of the Green Factor numerator for any one site.