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## INSURING “GREEN” ROOFS

*Regardless of where you stand on things like global warming and sustainability – there’s no denying that “going green” is a trend that’s here to stay. So, the idea of a Trends Paper on green roofs seemed timely and interesting. Only problem is, “green roof” means different things to different people. For example, in the renewable energy sector, a green roof might be one with solar panels. Those in the more traditional building trades and architecture might refer to a roof that is covered with living vegetation as “a green roof” (though, the standard terminology in that sector really is a “vegetative roof”). And, I suppose, to lovers of fairy tales, homes and cottages with thatched roofs might come to mind when they hear “green roof”. (Thatching, of course, is dried, so it really isn’t a green roof at all – but it probably pops into many peoples’ head when they are not familiar with the other types of roofs.)*

*So, to clarify: in this paper, the green roofs we’re talking about are vegetative roofs, which are roofs that have a layer of growing plants covering all or a portion of them. Also note that we’re not talking about rooftops that might have some planted elements (trees, shrubs, plants, and so on) in moveable containers or what some might call rooftop gardens, unless a portion of the roof also includes a vegetative-based rooftop.*

### History of Vegetative Roofs

Vegetative roofs as we think of them today (in other words, not taking into account things like sod roofs, which purportedly go back to Viking times<sup>1</sup>) have been around for over 40 years<sup>2</sup>. And, as of at least 2008 it is reported that there are over 2 billion square feet of extensive green roofs built in Germany alone.<sup>3</sup> (Indeed, according to one source, about 12% of all flat roofs in Germany have green roof systems.<sup>4</sup>)

A recent survey report shows that in North America the green roof phenomenon is on the rise. According to the survey, in 2013 the green roof industry grew by 10% in North America, with nearly 6.5 million square feet of green roof space installed in 2013 on 950 projects.<sup>5</sup> That figure is up from 5.5 million square feet installed in 2012. Of the 6.5 million installed in 2013, over 4

<sup>1</sup> See, for example, information on the history of green roofs on the British Columbia Institute of Technology’s Centre for Architectural Ecology website: <http://commons.bcit.ca/greenroof/faq/what-is-the-history-of-green-roofs/>

<sup>2</sup> Miller, C. “Extensive Vegetative Roofs, <http://www.wbdg.org/resources/greenroofs.php>. (Hereafter referred to as Miller.)

<sup>3</sup> Breuning, J. “Fire & Wind On Extensive Green Roofs,” paper presented at the Greening rooftops for Sustainable Communities Conference, 2008 Conference Proceedings. (Hereafter referred to as Breuning.)

<sup>4</sup> According to Factory Mutual Insurance Company, “[t]ypical green roofs can retain over 60% of the initial precipitation they receive”. FM Global’s Property Loss Prevention Data Sheets on Green Roof Systems, April 2011, a p.21 (hereafter FM Global).

<sup>5</sup> Report by Green Roofs for Healthy Cities: 2013 Annual Green Roof Industry Survey, published April 2014, at p. 5, [www.greenroofs.org/resources/GreenRoofIndustrySurveyReport2013.pdf](http://www.greenroofs.org/resources/GreenRoofIndustrySurveyReport2013.pdf).

million were extensive green roofs.<sup>6</sup> In terms of the top 10 North American cities with the most green roofs installed in 2013, Toronto, Montreal, and Calgary were ranked numbers eight, nine, and ten, respectively.<sup>7</sup> Washington, D.C., ranked number one with over 2 million square feet installed in 2013. Chicago was second, with under 800,000 square feet, and each of the three Canadian cities in the top 10 came in at under 200,000 square feet installed.<sup>8</sup>

As technology evolves, green roofs are finding support in more-and-more communities throughout North America and industry and trade groups, like Green Roofs for Healthy Cities<sup>9</sup>, which is a Toronto-based not-for-profit aimed at fostering the industry throughout North America, and the Leadership in Energy and Environmental Design (LEED) building rating system, are promoting their use. And, as their popularity grows, green roof technology and standards are being incorporated into building codes. Some cities, like Toronto, are going even further and are mandating the construction of green roofs on some new developments.<sup>10</sup>

Lest you think that Canada is always on the cutting edge, people out west might remember news stories about Vancouver's original requirement that there be green roofs on the 2010 Olympic Athletes Village. The plans were dropped in 2007 after stories came out warning that local insurers might be unwilling to insure the buildings that were to be sold as condos after the games if they had green roofs.<sup>11</sup> None of the insurance industry experts spoken to for this paper had any direct knowledge about the Vancouver Olympic Village situation, but they all thought that the building problems that plagued the B.C. condo industry in the 1980s and 1990s likely contributed to any insurance industry skittishness that was raised at the time. "B.C. has a history of leaky condos and ensuing water damage issues, so that probably had a large part to do with it," says Peter Kennedy, Senior Vice President and National Director, Aon Risk Solutions, Real Estate Practice.

### **Types of Vegetative Roofs**

There are two main categories into which vegetative roofs generally fall: extensive and intensive. Many in the vegetative roof industry also mention a third category, which is basically a roof with both extensive and intensive sections. Vegetative roofs can be installed on commercial and non-commercial buildings.

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<sup>6</sup> Id at p. 7.

<sup>7</sup> Id at p. 4.

<sup>8</sup> Id.

<sup>9</sup> <http://www.greenroofs.org/>.

<sup>10</sup> According to the City of Toronto's website, "Toronto is the first City in North America to have a bylaw to require and govern the construction of green roofs on new development. It was adopted by Toronto City Council in May 2009, under the authority of Section 108 of the City of Toronto Act.

"The Bylaw applies to new building permit applications for residential, commercial and institutional development made after January 31, 2010 and will apply to new industrial development as of April 30, 2012."

<http://www1.toronto.ca/wps/portal/contentonly?vgnextoid=83520621f3161410VgnVCM10000071d60f89RCRD&vgnextchannel=3a7a036318061410VgnVCM10000071d60f89RCRD>.

<sup>11</sup> <http://www.canada.com/topics/news/national/story.html?id=a2b47a90-4201-4d35-9533-87dbc5a61288>.

Extensive vegetative rooftops are generally defined as roofs with vegetation that is six inches or shallower. Extensive systems are often used on smaller areas and are ideal for small residential and commercial properties.<sup>12</sup> Once the plants in extensive systems are fully established, they are intended to require little to no maintenance.

Intensive rooftops have plantings that are deeper than six inches and so they can support bigger plants, including shrubs and trees, and they often are part of structural landscaping and promenades.<sup>13</sup> An example of this might be a “green space” that has some recreational space or common area atop a garage that connects a high-rise cluster of buildings – that could well be an intensive rooftop. Intensive rooftops normally require regular maintenance, including irrigation and fertilization.

Here are a few photos of green roofs (provided by, and used with the permission of Sedum Master Inc.):



The one on the left is a residential installation, the one in the middle and on the right are commercial installations.

### Why a Green Roof?

Given the moniker of green roof, most people would guess that the main benefit of a vegetative roof is that it conserves energy. Though there are studies that support the idea that green roofs save energy<sup>14</sup>, the energy conservation potential of vegetative roofs is not conclusive. In warmer weather they help keep the surrounding air cool, which lowers the temperature of the soil surface, thereby decreasing the heat flow through the roof. In the winter they may help retain heat.<sup>15</sup> Many would argue that for new construction that is built to modern energy codes, vegetative roofs have little impact on building energy consumption. But, for older buildings that are being retro-fitted with a vegetative roof, the savings in terms of air conditioning and heating attributable to such a roof can be significant.

Besides energy conservation, there are other important potential benefits to green roofs<sup>16</sup>:

<sup>12</sup> RiverSides™ Toronto Homeowners' Guide to Rainfall, [http://www.riversides.org/rainguide/riversides\\_hgr.php?cat=2&page=54&subpage=57](http://www.riversides.org/rainguide/riversides_hgr.php?cat=2&page=54&subpage=57).

<sup>13</sup> See Miller, *supra* note 2.

<sup>14</sup> *Id.*

<sup>15</sup> *Id.*

<sup>16</sup> Most of the information regarding the benefits of green roofs comes from Miller, *supra* note 2.

- **Controlling storm water runoff** – the idea here is that the vegetation absorbs some water and so the intensity of the storm water runoff is diminished.<sup>17</sup> Through careful selection of materials used in the various layers (see Components of a Green Roof, below), specific levels of storm water runoff can be achieved. Obviously, the bigger the area of vegetation, the more effective the roof is at managing storm water. In effect, vegetative roofs have engineering features that are similar to conventional storm water management basins and often offer a practical solution in areas where there isn't space for other methods of storm water management.<sup>18</sup>
- **Improved Municipal Water Quality** – this relates to the volume and rate of storm water runoff, as well as the fact that there is far less dust released by vegetative roofs, which means less nitrogen and phosphorus released into receiving waterways.
- **Urban Heat-Island Effect is Mitigated** – because vegetative roofs absorb less solar radiation (especially by comparison to conventional dark roofs<sup>19</sup>) they generate a lower ambient air temperature, which helps reduce the heat-island effect that's particularly pronounced in urban areas.<sup>20</sup>
- **Air Quality Improved** – green roofs help improve air quality because the vegetation filters dust, absorbs carbon dioxide, and produces oxygen.<sup>21</sup>
- **Extending the Life of the Roof** – based on Germany's experience with green roofs, it seems they may protect underlying roofing materials in a variety of ways. They protect from mechanical damage, by shielding against ultraviolet radiation and by moderating temperature extremes, which helps minimize expansion and contraction of roof materials. Betty Hornick, National Commercial Team Leader, Product Development, National Commercial Underwriting at Aviva, also points out that green roofs virtually eliminate hail damage to roofs. "Hail is the single largest roof-related exposure for insurers, so in a hail storm a green roof would be a good thing – and the plants used are hearty and hail damaged plants are known to heal completely in five to six weeks," says Hornick.
- **Reduces Sound Reflection and Transmission** – the added weight of a vegetative roof results in increased sound insulation for the building. As well, vegetative roofs can absorb some of the neighbouring sounds that would otherwise bounce off hard roofing surfaces.
- **Aesthetic Value** – vegetative roofs can transform the urban landscape by improving views and allowing structures to merge with surrounding landscapes. Having a view of a vegetative rooftop can also increase property values.<sup>22</sup> And, depending on the size, scope, and location, green roofs can provide welcoming, peaceful, restorative public space. As a result, vegetative roofs can attract potential tenants and owners.

<sup>17</sup> See FM Global, *supra* note 4 at p. 21.

<sup>18</sup> Id.

<sup>19</sup> Yes, by the same logic, simply painting a roof white will help in the same way. But, as they age, white roofs tend to lose their ability to reduce temperature, while vegetative roofs do not. Miller, *supra* note 2.

<sup>20</sup> See FM Global, *supra* note 4 at p. 21.

<sup>21</sup> RiverSides™ Toronto Homeowners' Guide to Rainfall, [http://www.riversides.org/rainguide/riversides\\_hgr.php?cat=2&page=54&subpage=57](http://www.riversides.org/rainguide/riversides_hgr.php?cat=2&page=54&subpage=57).

<sup>22</sup> Miller, *supra* note 2.

### The Components of a Green Roof

Green roofs can be installed on concrete, steel, or wood roofs. Starting from the rooftop, the key components of a vegetative roof are:

- **Waterproofing layer** – this is typically a membrane that’s laid directly on the roof decking. It must be puncture resistant and resistant to chemicals, such as fertilizer.
- **Insulation layer** – this layer is sometimes included to enhance energy savings and to provide added protection for the waterproofing.
- **Layer for drainage/moisture retention** – this layer ensures that water drains away from the vegetation so that plants don’t die from being too moist, and it prevents water from draining out in a way that causes the plants to dry out. The design and materials used in the drainage layer will depend on a number of factors. For example, if the roof is sloped, drainage occurs naturally and so a gravel perimeter might be required to ensure that the excess water drains into the gutter. If the roof is flat, drainage mats that are honeycombed might be required, and so on.
- **Root barrier** – this is designed to ensure that the roots of the vegetation don’t damage the waterproofing layer. The root barrier also protects the waterproofing layer from harmful microbes.
- **Growing medium** – the growing medium is not garden variety soil. Instead, it is engineered and lightweight so that it does not clog the drainage system. It contains porous aggregate (for example, crushed clay brick, pumice, and so on) to allow for water retention and water drainage and it must resist compacting, as well as provide nutrients for the plants.
- **The plants** – the types of plants used (often sedums, which are succulent alpine plants<sup>23</sup>) will depend on the roof design and climate. The plants should be drought resistant, fire-resistant, wind resistant, have good regenerative capability, and be suitable for the microclimate that will exist on that particular rooftop. (For example, there may be higher wind on the rooftop than at ground level, there may be reflected light, and so on.)

If public access is allowed on the roof, or if special circumstances apply, additional components might be needed, as well as additional reinforcement if the system is particularly heavy.

Because the soil on extensive roof systems is only about six inches deep, the type of plant used must have a good horizontal root system. They are generally lower maintenance plants and should be drought resistant because normally extensive roof systems do not have mechanical irrigation systems. As well, they should be hearty enough to survive wide temperature extremes.

Intensive roofs feature deeper soil (typically six to 10 inches) and often have mechanical irrigation systems so the choice of plants can include small shrubs and bushes.

### Risks Associated with Green Roofs

As with any structure, there are risks associated with green roofs. Here are the main risks insurers normally consider:

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<sup>23</sup> The Oxford Dictionaries (on-line) defines sedum as: “A widely distributed fleshy-leaved plant with small star-shaped yellow, pink, or white flowers, grown as an ornamental.” <http://www.oxforddictionaries.com/definition/english/sedum>.

- **Fire** – When Toronto introduced its by-law there were new reports about whether there were fire hazard concerns with improperly maintained green roofs.<sup>24</sup> The concern then seemed to be that if the vegetation were to allow to dry out it might be more flammable. As well, some voiced concern that a fire on a green roof could spread to surrounding areas, much like a wildfire might. Research has shown, however, that “[i]t is nearly impossible to set an extensive green roof on fire which spread over the roof or starts a glowing/burning of the growing media. The risk of fueling fires is 15-20 times higher on bare roofs with fully adhered bituminous waterproofing membranes as on extensive green roofs with grasses, perennials and Sedums.”<sup>25</sup> And, according to information provided by Aviva’s Hornick, fire on a green roof does not provide a significant insurance exposure because the vegetation burns quickly, leaving the growth medium that is mainly gravel, which Underwriting Laboratories of Canada considers a fire rated roof cover.

A 2012 report by the Fire Protection Research Foundation noted three fire issues related to vegetative roofs: flammability of materials, flammability of vegetation (which has implications regarding the spread of fire), and firefighter access.<sup>26</sup> The report also notes, however, that steps can be taken to mitigate the flammability of materials risks, including design features and choices of building materials.

Interestingly, in Germany, where green roofs have a long history, not only is there little concern about fires related to them, there is an insurance advantage, as having a green roof can translate into a 10-20% discount on fire insurance.<sup>27</sup> There is anecdotal evidence of an insurance benefit here in Canada too. Paul Johnstone, Senior Vice President, Chubb Insurance Company of Canada, agrees that there can be situations where having a green roof might reduce exposure to fire risk. He gave the example of a Chubb home appraisal for a client out west, where wildfire is a particular risk that Chubb assesses. The appraisal confirmed the home had a reduced exposure to wildfire because the membrane on the green roof was fire rated and the roof was designed to irrigate and re-circulate grey water.

- **Wind erosion** – wind can cause all sorts of damage, including erosion of roof surfaces. The issue of whether wind erosion damage is worse on a green roof than on a regular roof has been studied. Until the plants have fully taken root, they are more vulnerable to wind erosion. How long it takes for establishment of plants depends on a number of factors, such as the type of plant, whether they are started from plugs or seeds, and so on. Plants installed on roofs often come in blankets, much like sod, with roots already established.

Studies have shown that green roofs constructed with erosion safeguards (for example, erosion blankets and mature plants that have been properly planted) pose no additional loss of materials during high wind events.<sup>28</sup>

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<sup>24</sup> See, for example, “Fire safety issue raised for green roofs”, by Peter Kenter, Daily Commercial News, <http://dcnonl.com/article/id34469>.

<sup>25</sup> See Breuning, *supra* note 3 at p. 2.

<sup>26</sup> Meacham, B., Poole, B., Escheverria, J. Cheng, R., “Fire Safety Challenges of Green Buildings, Final Report,” The Fire Protection Research Foundation, at p. 53, <http://www.nfpa.org/research/fire-protection-research-foundation/reports-and-proceedings/building-and-life-safety/general-life-safety-issues/fire-safety-challenges-of-green-buildings>.

<sup>27</sup> See Breuning, *supra* note 3 at p. 3.

<sup>28</sup> Wanielista, M., PhD. P.E., Minareci M., M.S. E.I., Catbas, N. PhD, P.E., and Hardin, M., M.S. E.I., “Green Roofs and Wind Loading”, a 2011 report of the University of Central Florida, Stormwater Management Academy, <http://www.stormwater.ucf.edu/sealofapproval/GreenRoofsandWindLoadingsDraftFinalReport.pdf>.

In fact, there is evidence that a green roof installation increases wind resistance beyond gravel ballast that is used on many roofs.

- **Leaks and water damage** – on the issue of leaks and water damage, as Kennedy of AON puts it, “typically you want to get water off a roof and away from the building, but with a green roof you tend to keep some water on the roof. Also, there’s the question of whether the plant roots or something else might pierce the waterproof membrane.” But the waterproofing membrane and proper drainage systems build into the system, as well as regular maintenance and inspection, greatly reduce the risk of leaks and water damage.
- **Added weight** – green roofs add additional weight that is both static and dynamic. The weight of the green roof components (the growing medium, the plants, irrigation system, and so on) is basically dead weight, so it’s fairly easy to determine. As well, because they are designed to retain water, they must be designed to support the additional weight of water and possibly ice. And, for roofs open to the public, there is still more dynamic weight to take into account.
- **If roof open to public** – any insurance risks related to a roof that has an extensive or intensive vegetative roof that is open to the public relate not to the fact that there is a green roof installation but to the fact that people are allowed on the roof.

### Insuring Green Roofs in Canada

Canadian insurers that normally provide insurance for buildings generally insure buildings with green roofs. “All insurance companies cover it and they have for a long time,” says AON’s Kennedy. In fact, such coverage is typically simply part of normal coverage. In the case of Aviva, for example, it’s covered by their standard commercial policy wording, says Hornick.

As well, Chubb’s Johnstone says, “We’re very comfortable with insuring them and our policies are silent on them, which means there’s no specific coverage and no specific exclusion related to them.”

But, given that the vast majority of roofs in Canada are not green roofs, there isn’t a lot of insurance industry-specific information about them in Canada. As Johnstone points out, less than 1% of their appraisals are for properties with green roofs. “Though we do have clients who have them, green roofs are expensive and for most people who invest in a green roof, it’s a commitment to being green,” says Johnstone.

Notably, none of the insurers interviewed for this paper were aware of any particular insurance claim-coverage disputes specific to green roofs. Part of the reason for this, however, might be the fact that they are simply covered under standard policy wording. Aviva’s Hornick, for example, agreed that one reason she isn’t aware of any specific claims issues might be because, “we don’t track them separately, we treat buildings with green roofs the same as we would any other commercial buildings.”

### What Canadian Insurers Ask When Providing Coverage

Given that green roofs are normally covered by standard policy wording, the installation of a green roof, in and of itself, doesn’t necessarily trigger specific investigation, inspection, or inquiry by insurers. To the extent that it does, however, AON’s Kennedy says they are likely to focus on three distinct issues: design, construction, and maintenance. “With respect to design, they’re interested in who designed/built the vegetative roof, whether the methodology and materials used were proven, what the weight load is – that kind of thing. In terms of construction, insurers would be interested in whether it’s on a new building or if

it's a retrofit and who installed it. Regarding maintenance, they'd be interested in the type of maintenance that will be required, who'll carry out the maintenance, how often they'll inspect for problems, etcetera," says Kennedy.

Chubb conducts a home appraisal for every property it covers, whether there's a green roof or not and "Chubb takes account of the green roof because insuring to value is paramount," says Johnstone.

Retrofitting a roof to accommodate a green roof is a bit different. AON's Kennedy points out that any time an insured is planning a major renovation they should notify their insurer. As for whether installation of a green roof on an existing building is of particular concern, Kennedy says that any renovation is higher risk than construction of a new building, but with a retrofit to install a vegetative roof, the increased risk is more inherent in the renovation.

"If it's a retrofit, we want more details about how it's been done," says Aviva's Hornick. "We'll want to know, for example, can an older building sustain the weight? For this, we'd review structural design data provided by the engineering company. If an underwriter has concerns with a retrofit, they can request an inspection. We're looking to see whether it meets acceptable design standards. If we're not comfortable with it, we won't write it. Or maybe we'll include a seepage and leakage exclusion, for example. If the retrofit was done some time ago, say, five years ago, we'd want to look at loss experience to determine if there are any issues or concerns.

"Although green roofs have been around for some time, underwriters would assess the risk and generally ask additional questions with respect to maintenance of the green roof and the maintenance of the roof and membrane. We might ask about the age of the membrane and roof covering, and how they check for damage, for example," says Hornick.

### **Conclusion**

Green roof technology has come a long way over the past 40 or so years and it's clear the insurance industry has developed comfort with such roofs. There's little doubt that green roofs are here to stay. In cities across Canada, green roofs are being embraced as a way of changing the urban landscape. They're also being installed in suburban areas on things like industrial parks, shopping malls, and other commercial properties.

As existing green roofs age, and as technology, design, and architecture standards evolve, it will be interesting to see whether the insurance industry's response or treatment of green roofs will change. Like many things, only time will tell. . .

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