

Appendix 16: Green Roofs Guidance Document

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1.1 Introduction

1.1.1 The Aim of this Guidance Document

The aim of this document is to provide **brief** guidance on Green Roofs. It outlines the reasons why Dún Laoghaire-Rathdown County Council considers it appropriate to encourage the installation of Green Roofs and lists development types where Green Roofs would be appropriate.

1.1.2 What are Green Roofs?

Green Roofs are made up of layers that create an environment suitable for vegetation to grow. They are becoming increasingly important as a mechanism in attenuating stormwater run-off from sites.

1.1.3 Structure of a Green Roof

Usually, a Green Roof has a waterproof membrane at the bottom to protect the building from leaks. There is then an insulation layer and another protective layer, which will prevent damage from any penetrating roots, or other structural movement. Some designs may have the insulation layer as part of the protective layer. An insulation layer may also be placed above the protective layer instead of below.

A drainage layer is then put down over the insulation layer and the protective layer. The drainage layer can be made of lightweight gravel or light granulated clay. It helps to keep air in the Green Roof and soaks up any extra water. The drainage layer can also help store water for the plants to use at a later time. For maintenance purposes, it is important that the drainage points can be accessed from above. On top of the drainage layer, a filter mat may be installed to allow water to soak through. This will also prevent the fine soil from eroding.

The top layers of a Green Roof system include the soil layer (or substrate), plants and a wind blanket. The soil layer is made up of a lightweight material (for example, crushed clay bricks, clay granules etc) and will help with drainage as well as providing nutrients to the plants. The wind blanket protects the soil layer until the roots of the plants take hold.

1.1.4 Types of Green Roofs

There are two main types of Green Roof – Intensive and Extensive.

Intensive Green Roofs or Roof gardens provide similar benefits as a small urban park. They have a deep layer of soil, which can support a range of plants, trees and shrubs. Native species (plants which would grow naturally in the local area) can provide a rich habitat for wildlife. Intensive Green Roofs are designed to include access for people. These Roofs may require regular maintenance.

Extensive Green Roofs are more lightweight with a shallow soil layer and are not normally designed to provide access for people. They need little maintenance. There are three main types of Extensive Green Roof.

- Extensive Green Roofs, which are made up of sedum or vegetated mats – fabric mats that are prepared before the Green Roof is built. The mats are sprinkled with sedum cuttings. These are then left in appropriate conditions to grow into the fabric mat. Once the mats are ready, they are rolled up and delivered to the construction site and laid down on to the Roof.

- Extensive Green Roofs where a soil layer is laid down and then planted directly with small plants. These plants (often sedum) will have been grown in small pots. They are often known as plug plants.
- Extensive Green Roofs where the soil layer is laid down and then planted with seeds (which are suitable for the local environment). This type of Roof is often known as a 'biodiverse' or 'brown' Roof.



Examples of Extensive Green Roofs

1.1.5 The Benefits of Installing Green Roofs

Green Roofs can be designed to give a wide range of benefits. These include:

- Reducing the amount of surface water running off the Roof and so reducing the risk of flooding. Completed projects show a reduced annual run-off of at least 40% and more usually 60-70%. In some cases, for Intensive Green Roofs, the water retention can be up to 90%.
- Providing habitat (homes), shelter and feeding opportunities for wildlife.
- Contribute to sustainable drainage systems and water quality improvement.
- Helping to meet the targets of our biodiversity action plan.
- Improving the character and appearance of the building and the wider area.
- Offering an opportunity to boost the environmental credentials of a business.
- Providing extra heat and noise insulation.
- Keeping the building cool in the summer.
- Increasing the lifespan of the Roof membrane.
- Helping to reduce the amount of dust and pollutants in the air.
- Creating new open space for relaxation, providing potential for the creation of usable green spaces.

The driving force, however, for the installation of Green Roofs in our County is the need to maximise water retention capacity particularly as the Irish Climate Analysis and Research Unit (ICARUS) predicts that there will be a 12% increase in precipitation in winter by mid-century.

2.1 Relevant Policies

This Chapter lists the main policy documents that outline how the installation of Green Roofs will help to achieve some of the objectives underpinning current National and Local policies.

- National Climate Change Adaptation Framework, Building Resilience to Climate Change (Dec 2012)
- National Climate Change Strategy 2007 – 2012
- Greater Dublin Strategic Drainage Study 2005
- Water Framework Directive (2000/60/EC)
- National Biodiversity Plan 2002
- DLR’s Biodiversity Action Plan 2009
- DLR’s Green Infrastructure Strategy 2016 -2022

Further details of each of these Policy documents can be found in the Appendix.

3.1 Requirements for Various Land Uses

A Green Roof proposal is a requirement for all Roof areas greater than 300 square metres for the following development types unless exempted or partially exempted by DLRCC’s Municipal Services Section following consideration of the suite of complimentary or alternative “soft” SUDS (Sustainable Drainage Systems)* measures being proposed:

- **Apartment Developments**
- **Employment Developments**
- **Retail and Ancillary Shopping**
- **Leisure Developments**
- **Education Facilities**

Any habitable or employment related development type not covered under the above headings will be deemed to require the installation of a Green Roof unless exempted or partially exempted by DLRCC’s Municipal Services Section following consideration of the suite of complimentary or alternative “soft” SUDS measures being proposed.

Terraced, semi-detached or detached housing or mews developments are not required to have Green Roofs. However, their installation is encouraged, wherever practicable. In addition, developments which are located in close proximity to the sea and can discharge directly to sea via a dedicated/exclusive surface water pipeline of sufficient capacity for all predicated rainfall events (including the 1:1000 year rainfall event) may, by agreement with the Municipal Services Department, omit the Green Roof.

A Green Roof, where required, shall in all cases cover a minimum of 60% of the Roof area. The minimum soil thickness shall be 2 to 4cm for a Moss/Sedum type of Extensive Green Roof and 10 to 15 cm for a grassed type of Extensive Green Roof.

* Alternative soft SuDs measures include ponds, bioretention areas, detention basins, infiltration basins, filter strips, wetlands, swales, rain garden. (For the purpose of clarity - a proposal that relies solely on attenuation storage systems and/ or permeable paving as an alternative to the provision of a Green Roof will not be acceptable)

4.1 What Type of Green Roof is best for a Development?

The main benefit of the Green Roof will vary from one development type to the next. The following guide should help one ascertain the best type of Green Roof for each development proposal.

4.1.1 Reducing the Volume and Rate of Surface Water Runoff from a Roof

All types of Green Roofs will reduce the amount of surface water running off a Roof. Green Roofs hold on to rainwater in the short term and when the water begins to be slowly released, a large proportion will be retained with the plants and soil layer. Some rainwater will also evaporate back into the atmosphere.

How much water the Roofs will hold will depend on the time of year (plants and the soil layer will keep more water during the summer months), the size and depth of the Green Roof and the type of plants used. Intensive Roofs are likely to retain more water because of their size and deeper layer of soil.

Green Roofs are particularly suitable in Dun Laoghaire-Rathdown County as a significant proportion of the piped drainage network is combined (the pipe carries both surface and foul water). With increasing urbanization and infill development these combined drainage pipes are sometimes unable to cope with the increase in surface water run-off, with resultant flooding.

4.1.2 Designing for Amenity

Both Extensive and Intensive Green Roofs can add to the character and appearance of an area. However, Intensive Green Roofs are more suited as an area for people to relax in.

Intensive Green Roofs provide a pleasant area to look at, and people can also go onto the Roofs and enjoy an outdoor open space. These can be particularly valuable in built-up areas. However, Intensive Green Roofs cannot be used to justify reducing 'normal' open space requirements at street level.

4.1.3 Designing for Biodiversity

Although all Green Roofs support biodiversity, some can be specifically designed to maximise these benefits. Green Roofs can benefit biodiversity by:

- Providing habitat for wildlife
- Providing undisturbed areas for wildlife
- Providing linkages or 'stepping stones' between green spaces
- Compensating for habitats that are lost through urban development.

A study of 11 Green Roofs in Switzerland recorded 25 species of bird, 172 species of beetle and 60 species of spider using these Roofs (English Nature 2003). In the UK, Green Roofs are recognised as having the potential to provide compensation for the loss of brownfield sites where they provide important habitats for rare species such as the Black Redstart. The benefits of Green Roofs to biodiversity will be influenced by their size and structure (including soil depth, growing medium, hydrology, topography, aspect etc.).

A Green Roof built for biodiversity purposes is usually 'Extensive'. This is because Extensive Roofs are not used by people and can provide undisturbed habitats for plants, birds and insects. An Extensive Green Roof will have a shallow depth of soil between 5 and 20cm, which is capable of supporting sedum/ moss communities or wildflower meadows. However, an

Intensively designed Green Roof could also provide opportunities for biodiversity, if disturbance is kept to a minimum.

The larger the Green Roof area, the more habitats can be created and the greater its value will be to wildlife. Sedum communities do well in shallow soils of 0-5cm, while of depth of 5-15cm will be required to establish a wildflower area. The growing medium used on the Green Roof will greatly influence its biodiversity potential. A nutrient-poor growing medium will allow a greater diversity of wildflowers to thrive. Well-drained, nutrient poor soil with patches of bare ground may provide opportunities for many invertebrates; some of which are usually be associated with heaths, dunes and brownfield sites (Natural England 2007). A Green Roof with a varied micro-topography and micro-hydrology may enhance the total species diversity through the creation of a range of microclimates. Providing areas with different growing mediums (e.g. sandy and rocky substrates); a range of soil depths; different aspects; and micro-hydrological fluctuations will contribute to a more diverse range of microclimates.

It is particularly important to choose plants which will benefit the existing local environment. Native plant species, which are characteristic of the general area, will usually be of greater benefit to local fauna than non-native plants. It is important to avoid non-native species that have the potential to become invasive and spread into existing local habitats or green spaces. Advice from an organization that understands both the local ecology and the ability of plant species to survive at roof level should be sought.

References

Natural England (2003). Green Roofs: their existing status and potential for conserving biodiversity in urban areas. English Nature Research Report, No. 498. Peterborough, UK. English Nature.

Natural England (2007). Living Roofs Leaflet. Peterborough, UK. English Nature.

5.1 Costs and maintenance

5.1.1 Costs

The cost of a Green Roof per square metre (m²) varies depending on the type of Green Roof, what will it be used for and the quality. Extensive Roofs start from approximately €100 per m², although a basic 'biodiverse' Extensive Roof can be installed for much less than this i.e. approximately €45. An Intensive Green Roof will be more expensive than an Extensive Green Roof and the cost will vary depending on the design and the features to be included (for example, trees and ponds) – however the stormwater attenuation, amenity and biodiversity benefits are considerably greater.

Green Roofs can also save money as they provide insulation during both the winter and summer. This has been demonstrated in Canary Warf, one of the largest areas of Green Roofs in the UK. In 2003, it was discovered on one of the buildings that, since a Green Roof had been installed, the temperature stabilized on the level immediately below the Roof. Ventilation is no longer needed during the summer, and heating costs are reduced in winter. These savings can yield between €2.45 and €9.93 per m² annually dependent on the type of Green Roof¹.

5.1.2 Maintenance

Intensive Green Roofs will require regular maintenance. Lawns will require mowing weekly or fortnightly, plant beds may require weeding on a weekly or fortnightly basis during the growing season, and wildflower meadows may require annual mowing with the cuttings removed. Extensive Green Roofs should normally only require bi-annual or annual visits to

¹ As calculated by Klooster *et al.* (2008)

remove litter, check fire breaks and drains and, in some cases remove unwanted colonising plants. The highest maintenance regime is generally required in the first three years, and usually this should be made the responsibility of the Green Roof provider (Source: CIRIA C697)

Intensive Green Roofs need to be watered and weeded in the same way as you would a normal garden. Larger plants, shrubs and trees should be pruned to make sure they are safe during windy conditions. Drains and gutters should also be checked and cleared to avoid blockages.

6.1 Design

6.1.1 When to build a Green Roof

An ideal time to consider building a Green Roof is when the existing Roof needs to be replaced, or when a new building is to be developed. This way, features such as a waterproof layer and a protective root-resistant layer can be made part of the new Roof. It is possible to install a Green Roof onto an existing Roof, but this will mean taking into account the Roof's faults, such as any leaks and damage, and the Roof will not be able to resist roots.

6.1.2 Structural Capacity of the Roof

The structural capacity of the Roof is the weight which the Roof can hold without risking damage to the building. This will be an important factor in deciding what type of Roof can be installed. It should be included in the development proposal from the beginning. New buildings can be designed with suitable structural capacity for any type of Green Roof. Extensive Roofs weigh approximately 60 to 150kg/m² and Intensive Roofs weigh about 200 to 1000kg/m². More specific guidance on the structural design of slabs which support Green Roofs are contained in the Institution of Structural Engineers publication The Structural Engineer dated 6th January 2009.

6.1.3 Access to the Roof

It is important to consider how people will get onto the Roof, and how equipment and material will be taken onto the Roof. Green Roofs can be developed on most slopes. However, the flatter the Roof is, the easier it will be for people to get onto the Roof and maintain it. Safety when on the Roof should be part of the design process.

6.1.4 Selection of Plants and Growing Materials

The types of plants suitable for growing on a Green Roof will partly depend on the level of maintenance that will be available during its lifetime. It will also depend on whether the Roof has an in-built irrigation and watering system, or has areas of protection such as shade and shelter.

However, choosing local seed varieties will mean that both Extensive and Intensive Green Roofs can help local biodiversity. The windy conditions that often exist on a rooftop will also mean that hardy plants, such as mosses and stonecrops, will establish themselves and thrive more easily.

One can consider using crushed demolition waste on an Extensive Green Roof. This has environmental benefits including recycling materials, and reducing the need for transporting and getting rid of the waste. Crushed bricks and concrete form drainage and a soil layer that can support a range of plants and insects. This in turn, benefits other types of wildlife.

The possibilities for an Intensive Green Roof are considerably greater. The Roof can contain trees, shrubs, meadows, flowerbeds and even features such as a small pond.

Appendix

1. Useful References:

Building Greener - Guidance on the use of Green Roofs, green walls and complimentary features on buildings. Published by CIRIA London 2007.

The SUDS Manual (C697) published by CIRIA London 2007

Green Roofs over Dublin - A Green Roof Policy Guidance paper for Dublin City Council – Tepui 2008.

2. Relevant Policies

National Climate Change Adaption Framework, Building Building Resilience to Climate Change.

Under the “National Climate Change Adaptation Framework, Building Resilience to Climate Change” published by the Department of Environment, Community and Local Government, (Dec 2012) there is an onus on Local Authorities to “prepare, review and amend local development plans to mainstream climate change adaptation”.

The document emerges from the now held belief that climate change cannot necessarily be prevented and instead the focus is on the need to adapt to climate change. Adaptation is defined as “adjustment or preparation of natural or human systems to a new or changing environment, with the aim of moderating harm” (DECLG, Dec 2012). Mitigation refers to reducing activities that cause harm. It is further recognised in the strategy that adaptation needs to be planned, managed and monitored.

The National Climate Change Strategy 2007- 2012

Under the Kyoto Protocol, for the period 2007 – 2012, Ireland has to limit its average annual emissions to only 13% above the levels emitted in 1990. This equates to 8.137 million tonnes of CO₂. Further to this, the EU has made a commitment post 2012, that they will continue to reduce their emissions by an additional 30% (relative to levels in 1990). This 30% reduction is provided that other developed countries commit to a comparable emission reduction. However, even if there is no international agreement, the EU still commits to reduce emissions by a further 20%, post 2012. This means that there will have to be radical changes made across the Irish economy, “particularly in relation to the way Ireland produces and uses energy, in the built environment and in transport”.

It has been mentioned already that Green Roofs can help reduce a building’s energy consumption and thereby its carbon emissions, when used in conjunction with regular insulation material. To date, there has been no research done in Ireland to quantify these reductions within the Irish context, but there are data from studies in other countries.

Greater Dublin Strategic Drainage Study (Greater Dublin Strategic Drainage Study: Regional drainage policies Vol.3 March 2005)

The Greater Dublin Strategic Drainage Study is a series of policy documents developed in 2005 by the Dublin area local authorities including DLRCC. One of its objectives is to prepare plans and strategies to manage storm-water run-off in urban areas in addition to assessing the current run-off management practices.

This study states that at present, urban areas consume large volumes of drinkable water while discharging ever-increasing quantities of foul sewage and storm-water. In consequence, "traditional supply and disposal of water involves costly, energy-Intensive treatment and reticulation systems, with their associated environmental impacts".

An alternative management system is therefore recommended. The name of this alternate system is SuDS, Sustainable Drainage Systems. SuDS are a completely different way of handling storm-water run-off. In the past, the main emphasis was on handling the volumes of water and clearing it from the surface but this system is an integrated approach that "addresses water quality, water quantity, amenity and habitat". According to the drainage study, it is of the utmost importance to consider all of these aspects when implementing SuDS.

Green Roofs are an important aspect in the implementation of SuDS, as Green Roofs reduce the quantity of run-off, improve water quality and provide valuable new habitat in urban areas. It is also important to note that the drainage study recommends that a "SuDS system be mandatory in all new developments unless the developer can demonstrate to the Local Authority that its inclusion is impractical due to site circumstances or that its effect on the control of run-off would be minimal, such as rural sites".

Water Framework Directive (2000/60/EC)

The Water Framework Directive (WFD) evaluates all the objectives used to protect aquatic environments and it aims to ensure that the relevant steps are taken to achieve the objectives. In essence the framework promotes a sustainable approach to water management. One main requirement is to manage surface run-off such that its impact on the surrounding environment is mitigated. SuDS techniques are a very effective means of reducing the rate and volume of run-off and to remove pollution.

Under the same directive, Ireland has to achieve a 'good water status' in surface and groundwater by 2015 and according to the Environmental Protection Agency (EPA), this will be a challenging target to meet.

In regards to water management, Dun Laoghaire Rathdown County Council's Green Roof policy creates another template by which we achieve some of the objectives outlined both in the Greater Dublin Strategic Drainage Study and the Water Framework Directive.

Dun Laoghaire Rathdown County Council Biodiversity Action Plan 2009 and National Diversity Plan 2002

Biodiversity advantages of Green Roofs are as follows:

- Helping to remedy areas of deficiency by providing new habitat in areas which are currently lacking in wildlife habitat
- Creating new links in an intermittent network of habitats thereby facilitating movement and dispersal of wildlife
- Providing additional habitat for rare, protected or otherwise important species

Two of the major threats to biodiversity outlined in the Biodiversity Action Plan are loss of extent and habitat fragmentation. Loss of extent refers to the removal of an area of habitat. In urban areas replacement sites are not easily found. However, installing Green Roofs assists greatly in creating additional habitats in an urban environment.

The second threat, habitat fragmentation, refers to breaking up large areas of habitat into smaller areas thereby making it more difficult and dangerous for fauna to travel between them for food and shelter. Green Roofs provide both a valuable transport network and help link green corridors through the city. This is especially important when taken into the context of biodiversity and climate change. The impact of climate change on biodiversity will depend on a 'species or habitats capacity to change'. The most vulnerable are those who have a restricted range and have no means of moving from one area to another.

It is important to note that one of the actions of the National Biodiversity Plan is to “encourage and promote beneficial effects on biodiversity”. This would be the outcome as Green Roofs are installed throughout the County. It would serve as an example for other councils around the country as an effective way of enhancing biodiversity as well as the other benefits previously mentioned.

Dún Laoghaire-Rathdown County Council Green Infrastructure Strategy -2016- 2022

DLR’s Green Infrastructure Strategy includes a section of Water Management that identifies examples of Green Infrastructure that incorporate a water management function. Green Roofs are identified as a SUDS measure that can assist with improving water quality and also a role in preparing and mitigating the impacts of climate change.”