Plan for a Green Economy

OASIS

A PROGRAM TO PREVENT AND REDUCE THE RISKS ASSOCIATED WITH CLIMATE CHANGE THROUGH GREENING

GUIDELINES FOR FOSTERING THE RESILIENCE OF GREEN INFRASTRUCTURE

Votre gouvernement

Québec

COORDINATION AND EDITING

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TO OBTAIN INFORMATION ON THE PROGRAM

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1. Background

At this stage, the applicant has a territorial plan for the green infrastructure to be implemented to respond to current and projected risks of heat on health, and the current and projected risks of heavy rainfall on infrastructure.

This green infrastructure will be exposed to a range of hazards that are likely to change in intensity, duration and frequency over the coming decades as a result of climate change. To play its role throughout its lifetime, the infrastructure will need to be resilient to current and future climate conditions.

2. Objective

These guidelines are intended to support the assessment of the climate change resilience of the planned green infrastructure by identifying potential hazards or issues that could impact it so that they can be taken into account starting from the design stage.

At the end of the process, the applicant will demonstrate that the green infrastructure they plan to implement will be resilient to current and projected climate change impacts.

3. Assessing the resilience of green infrastructure

This section addresses the risks posed by climate change to green infrastructure. As the expected changes in heat and heavy rain have already been qualified in a risk analysis, and as these are the two most significant hazards for the resilience of green infrastructure, this section aims to provide additional elements to consider when assessing the risk to green infrastructure.

At the end of this process, the planned green infrastructure will be able to be implemented at the prioritized locations, with its design and maintenance having been adapted to the impacts of climate change.

3.1 The nature and components of green infrastructure

Examples of green infrastructure to combat heat and heavy rainfall include green roofs, bioretention ponds, rain gardens, trees and other vegetation, and permeable paving.[1] A green infrastructure can therefore be made up entirely of plants (e.g. trees) or be a mixture of plants and grey infrastructure[2] (e.g. a bioretention pond). In all cases, resilience assessments should focus on both plant and non-plant components.

[1] Swanson, D., Murphy, D., Temmer, J., Scaletta, T. (2021). *Advancing the Climate Resilience of Canadian Infrastructure: A review of literature to inform the way forward.* International Institute for Sustainable Development. 130 pages.

[2] Canadian Council of Ministers of the Environment (2021). *Natural Infrastructure Framework: Key Concepts, Definitions and Terms.* Canadian Council of Ministers of the Environment. 61 pages.

3.2 Design considerations for green infrastructure

3.2.1 Plant components

Two main considerations should guide plant selection: a) the current and future environmental and climate conditions at the planting site; and b) the potential impacts of the plants on public health and the environment. The first consideration is to ensure that the right species are planted in the right location, and the second is to ensure that the species chosen do not exacerbate the effects of climate change on public health and the environment.

a) Environmental and climate conditions

The longevity of a green infrastructure component depends directly on the choice of plant species. This choice must take into account the constraints of the planting site (e.g. presence of de-icing salts, compacted soil, shady environment, etc.), as well as current and future climate conditions. Due to climate change, current climate conditions are not representative of future climate conditions. For plants with a long lifespan, such as trees, we need to consider not only current climate conditions, but also future climate conditions over a timeframe that corresponds to their lifespan.

Climate conditions can affect plants differently, depending on the species' sensitivity to drought, flooding, storms that can damage or uproot them, or winter warm spells that can injure bark and roots, or even interfere with their dormancy cycle. As a result, the hazards to consider when choosing plants are heavy rainfall, higher ambient temperatures, drought, winter warm spells (e.g. freeze-thaw cycles) and more intense and frequent storms.

Climate change can have an impact on other environmental components, which in turn affect plant survival. They can lead to shifts in the ranges of plant species[3] and the introduction of pests and exotic diseases. Since there are still a number uncertainties as to the cascading impacts of climate change over the longer term, there are no unequivocal answers as to the choice of plants to be planted, especially if they will be in place for several years. Therefore, a good practice for maximizing the resilience of plant communities is to diversify the plant species that make up green infrastructure as much as possible.

[3] Current and projected climate niches for over 3,000 plant species can be viewed on the Natural Resources Canada website via this link: Plant Hardiness of Canada (planthardiness.gc.ca).

Approach to tree species diversification

When it comes to trees, the choice of species to be planted can be based on the functional diversity approach, which groups tree species based on common characteristics. These characteristics have an impact on the species' tolerance for certain hazards, such as droughts or floods. According to the David Suzuki Foundation: [Translation] *"The functional diversity of an urban forest is a good indicator of its vulnerability. Generally speaking, the more diverse and complementary the biological characteristics of the species in an area, the more resilient the area will be to disturbances, despite the uncertainty associated with global changes. [...] In Québec, the main tree species that are typical in urban environments (native and ornamental) are divided into nine subgroups. Within these, the species have similar biological characteristics (and therefore similar vulnerabilities). For example, maple trees (group 2AB) are resistant to rain and floods but are vulnerable to droughts and high winds, while oak trees (group 4A) are more tolerant of droughts."*[4] This approach does not aim to maximize the number of unit species, but rather the number of groups with complementary characteristics.

b) Impacts on public health and the environment

Where possible, it is advisable to avoid plant species that have known negative impacts on health and the environment.

Examples of negative impacts on public health:

- Allergic reactions: Plants producing allergenic pollens such as birch, alder and elm trees[5] should be avoided, especially in densely populated areas.
- Skin reactions: Plants known for their toxicity, such as giant hogweed, should be avoided.

Examples of negative environmental impacts:

- Degradation of biodiversity: Invasive species,[6] such as Japanese knotweed, European buckthorn and common reed, are to be avoided.
- Interference with the built environment: Certain areas, such as Hydro-Québec's rights-of-way[7], are subject to specific landscaping constraints that must be understood and adhered to.

[4] David Suzuki Foundation (2022). *Increasing Equitable Adaptation to Climate Change: Scenarios for Planting 500,000 New Trees in Montreal.* David Suzuki Foundation. 57 pages.

[5] Espèces de pollens allergènes présentes au Québec - Herbe à poux et autres pollens allergènes - Professionnels de la santé - MSSS (gouv.qc.ca) [In French only]

[6] Espèces exotiques envahissantes (EEE) (gouv.qc.ca) [In French only]

[7] Hydro-Québec's tree and shrub directory: Hydro-Québec's tree and shrub directory | Hydro-Québec (hydroquebec.com)

3.2.2. Non-plant components

As with plant components, the non-plant components of green infrastructure must remain functional throughout the infrastructure's lifetime. The hazards to be considered when assessing the resilience of non-plant components of green infrastructure will depend on their function and nature. For example, for components designed to contain or direct rainwater until it is absorbed by plants, the impact of hydrometeorological hazards must be taken into account when determining the capacity, in terms of volume, of this infrastructure.

3.3 Maintenance considerations for green infrastructure

All of the precautions taken at the design stage of green infrastructure may not be enough to guarantee their resilience in the face of uncertainties related to the changing climate, nor in the face of non-climate hazards nature, such as exposure to de-icing salt.

A green infrastructure monitoring and maintenance program will help mitigate residual risks and provide the corrective action necessary to keep the infrastructure in good working order. The program could include, for example, the installation of an irrigation system to ensure that plants are sufficiently watered during hot and dry periods and the periodic replacement of dead plants.

Conclusion

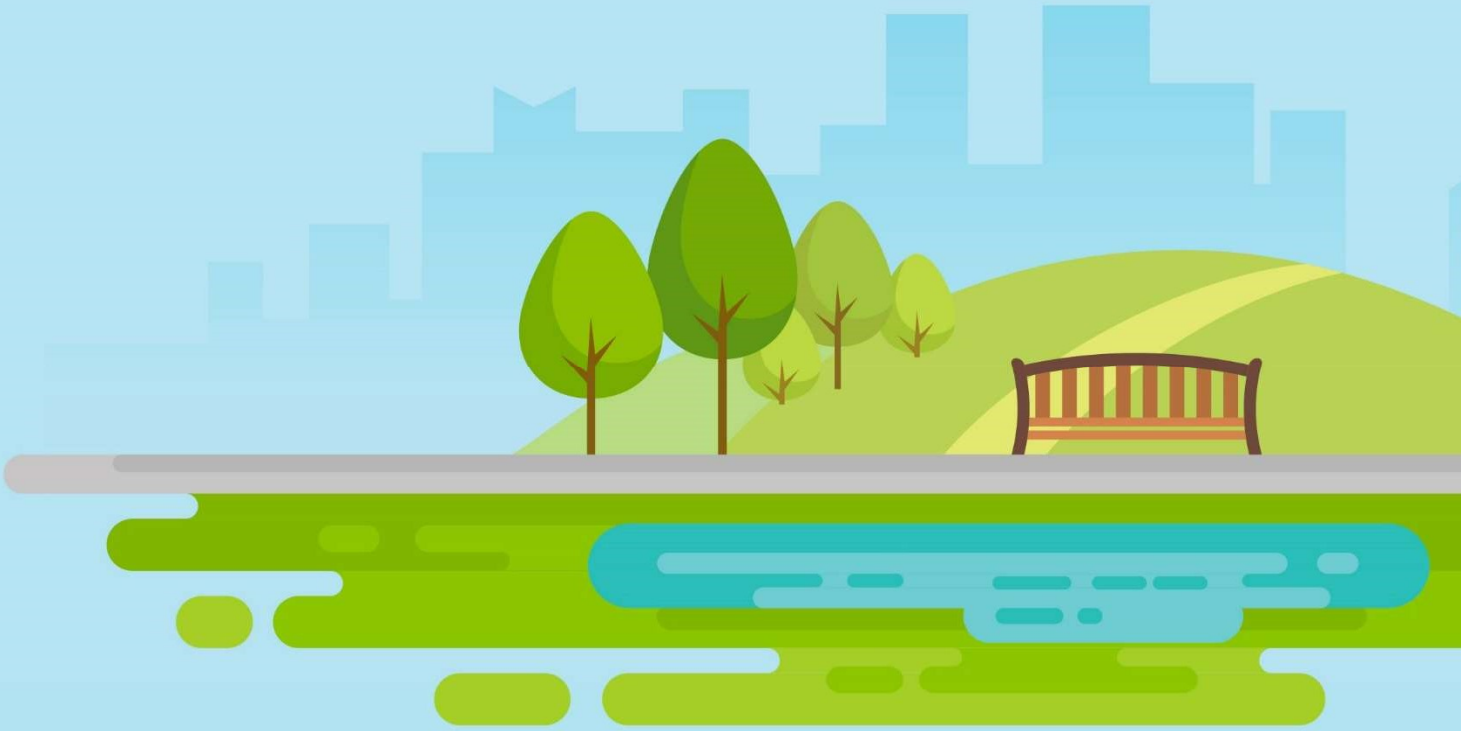
At the end of the green infrastructure resilience assessment process, the municipal body or Indigenous community must provide:

- A list of all planned green infrastructure and, for each type of infrastructure, a short summary explaining why and how it will be resilient to the current and future climate. The expected lifespan of the green infrastructure must be indicated, and a description of any adaptation measures adopted must be provided.

Summary of green infrastructure resilience assessment criteria

Applicants can use the following table as a checklist for the green infrastructure resilience assessment criteria presented in this document.

Assessment criteria	**Check when done**
Component identification	
Plant and non-plant components have been identified for each type of planned green infrastructure.	
Component lifespans	
The lifespan of each plant and non-plant component has been determined.	
Plant components	
The constraints of the planting site as well as current and future climate hazards have been taken into account in the choice of species based on their life expectancy in order to maximize each one's chances of survival.	
The choice of species has been diversified as much as possible to promote the survival of the plant community as a whole.	
The potential negative impacts on public health and the environment have been taken into account in the choice of species.	
Non-plant components	
Depending on the function and nature of these components, the relevant current and future climate hazards have been taken into account in the design of the green infrastructure to ensure its proper functioning throughout its lifespan.	
Monitoring and maintenance program	
A green infrastructure monitoring and maintenance program has been set up to mitigate residual risks and ensure the infrastructure's proper functioning throughout its lifespan.	



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