



# Introduction to Green Infrastructure and Natural Assets in Health Care

Case Studies and General Information

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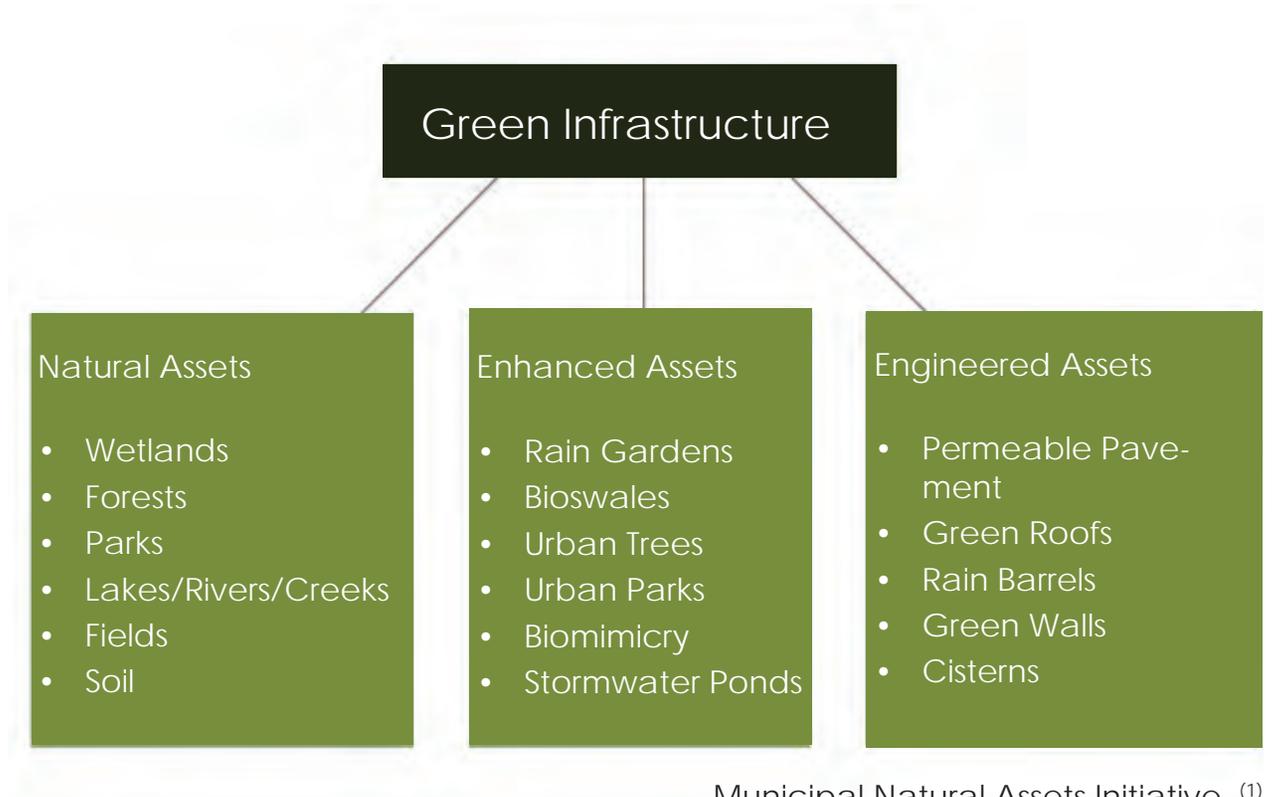
August 2024

Image: Delta Hospital

# What is Green Infrastructure?

“Green infrastructure is a broad category that includes natural assets and designed or engineered elements that have been created to mimic natural functions and processes in the service of human interests.”<sup>(1)</sup>

“Natural assets are the stock of natural resources and ecosystems that yield a flow of benefits to people.”<sup>(1)</sup>



Municipal Natural Assets Initiative.<sup>(1)</sup>

## Green Infrastructure in Healthcare

Additional types of green infrastructure are relevant specifically to healthcare and are included in this guide including:

- Healing Gardens
- Therapeutic Gardens
- Sensory Gardens
- Indigenous Healing / Medicine Gardens



# What is in this document?

This document is intended to inform on green infrastructure that could be or are implemented at Fraser Health Authority sites to benefit biodiversity.

The most impactful strategy to support biodiversity is to preserve and steward existing natural assets that act as significant ecosystems or habitat. There is potential to actively manage these assets to benefit both wildlife, patients, and staff of health care facilities. Examples of this in practice are shown in the first section.

Nature based solutions such as enhanced assets and engineered assets are a great next step. However, they should not replace the protection of existing natural habitats, as replicating those conditions can be costly, challenging, and maybe even impossible.

The second section elaborates on ways to enhance green spaces. This could be through a number of strategies such as incorporating more gardens. Various garden types and case studies are in section 2.

The third section specifies engineered assets. This is often a selection for highly urbanized spaces that are associated with man-made structures.

The last section provides examples of additional small scale habitat structures that can support local wildlife and pollinators.

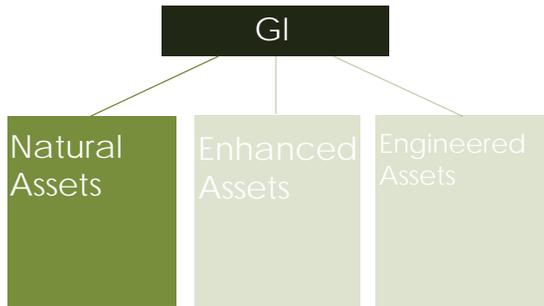
## **Disclaimer:**

Many types of green infrastructure, nature-based solutions and healing landscapes exist. The few highlighted in this document were chosen due to their potential to improve biodiversity and their potential applicability to Fraser Health Authority sites.

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# 1. Green Infrastructure: Natural Assets



Natural assets are a subset of green infrastructure and refers to natural stores of resources or naturally occurring ecosystems. The 'asset' component implies that they provide ecosystem services or benefits to people in some capacity. <sup>(1)</sup>

Natural Assets Applicable at Fraser Health Sites:

Forests  
Meadows  
Creeks



# 1.1 Forests

Fraser Health Authority falls within the Lower Mainland Ecoregion. This region is part of the coastal temperate rainforests and is characterized by the vast river flood plain and wet old growth forests.

These coastal western hemlock forests are the dominant ecosystem type of our region. They are significant ecosystems that host much of British Columbia's flora and fauna.

By preserving pockets of forest and natural spaces we have left in our urban areas we can greatly support local wildlife and native plant populations, while also reaping the many benefits that they provide. <sup>(2)</sup>



Image: Katie McPartlin, Burnaby Hospital

## Ecological Benefits To Preserving Local Forests

- Climate resiliency
- Carbon sequestration
- Flood mitigation
- Hosts vast amounts of biodiversity
- Critical habitat for a number of endangered species

### Local Resources For Forest Management:

#### Local Forest Management Plan Example

<https://vancouver.ca/files/cov/Stanley-Park-Forest-Management-Plan.pdf>

#### Consultancy / Construction

<https://www.diamondheadconsulting.com/services/#ecologicalrestoration> <https://firelight.ca/what-we-do/core-services/indigenous-health>

# Case Study: Forests in Healthcare Settings

## Blarbuie Woodland, Scotland



Argyll and Bute Hospital underwent a forest enhancement project in 2002, for patients, staff and visitors.

They created pathways, added signage, developed management plans and offered educational opportunities. <sup>(3)</sup>

## Partnerships

A joint project with:  
Reforestation Scotland,  
Argyll Green Woodworkers Association,  
National Health Services (NHS),  
Scottish Association for Mental Health,  
Lochgilphead Community Council.

Having community partners was essential to carrying out a project such as this. Research, consultation, and appraisal was completed with the help of partners. Followed by detailed planning and fundraising. <sup>(3)</sup>

## Stewardship

Ongoing monitoring and management of the woods would be required. According to their project page, community participation was key to protecting the woods long term and making them accessible to everyone. <sup>(3)</sup>

## Typical Requirements for Small Scale Forest Maintenance



Species and  
Ecosystem Monitoring



Invasive Species  
Removal



Trail  
Maintenance



Supplementary  
Planting

# 1.2 Meadows

Meadows are not a common ecosystem type for this Lower Fraser River region of BC, although semi disturbed sites often result in meadows. They can provide significant pollinator habitat and kick start natural succession by building soils.

Meadows also support grassland birds as well as aerial insectivores, a group of insect eating bird species that have been in decline since the 70s.<sup>(2)</sup>



Image: Katie McPartlin

## Ecological Benefits To Preserving Meadows

- Climate resiliency
- Biodiversity Benefits
- Pollinator habitat
- Critical habitat for a number of endangered species

### Local Resources For Meadow Management:

#### Local Meadow Ecosystems

<http://www.garryoak.info/><http://www.garryoak.info/>

#### Meadow-scaping

[https://wmswcd.org/wp-content/uploads/2016/04/Meadowscaping-Handbook\\_Printed-January-2022\\_web.pdf](https://wmswcd.org/wp-content/uploads/2016/04/Meadowscaping-Handbook_Printed-January-2022_web.pdf)

<https://northwestmeadowscapes.com/pages/planting-advice>

# Case Study: Meadows in Healthcare Settings

## Ysbyty Gwynedd Hospital, Bangor, Wales



Image: Cassie Crocker / Plantlife, May 2021.

Meadows Health and Wellbeing Route is a 1.7 km signed walking route developed from Ysbyty Gwynedd, a hospital in Bangor, to nearby meadows at Eithinog Nature Reserve. <sup>(4)</sup>

## Partnerships

This project is in partnership with Plantlife and is part of Magnificent Meadows Cymru, a government funded program that is working to restore over 500 hectares of wildflower meadows and grassland in Wales. These environments connect communities to natural spaces for health and well being. <sup>(4)</sup>



## Stewardship

On going monitoring and management of the meadows would be required. This particular site is connected to a nature reserve that takes on the bulk of the work. <sup>(4)</sup>

## 1.3 Creeks and Water bodies

Freshwater creeks run through or adjacent numerous Fraser Health Authority sites. This small water body is actually a really crucial part of our watersheds. They provide habitat and / or provisioning services for aquatic, semi-aquatic and terrestrial species. <sup>(2)</sup>

Maintaining an undeveloped buffer around creeks allows their riparian zones to effectively fluctuate with floods and droughts while also providing enough vegetation to clean runoff before it enters our waterways.

### Ecological Benefits To Preserving Riparian Areas

- Climate resiliency
- Erosion control
- Water quality treatment
- Flood mitigation
- Hosts vast amounts of biodiversity
- Critical habitat for a number of endangered species



Image: Katie McPartlin

### Local Resources For Creek Management:

#### **BC Riparian Guidebooks**

[https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/fish-fish-habitat/riparian-areas-regulations/guidebook-proponents\\_web\\_final\\_aug\\_2016.pdf](https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/fish-fish-habitat/riparian-areas-regulations/guidebook-proponents_web_final_aug_2016.pdf)

[https://stewardshipcentrebc.ca/PDF\\_docs/sar/GuidanceforRestorationActivitiesinRiparianAreasPilot12-2013.pdf](https://stewardshipcentrebc.ca/PDF_docs/sar/GuidanceforRestorationActivitiesinRiparianAreasPilot12-2013.pdf)

# Case Study: Creeks in Healthcare Settings

## Methodist Hospital, Minneapolis, US



1460 ft of stream bank restored, 4 acres of wetland restored, and 10 acres of green space made accessible by the The Minnehaha Creek Methodist Hospital Re-meander project.

In 2009 this collaborative restoration reshaped the creek to its natural form, thereby improving wildlife habitat and flood resiliency. The hospital complemented the creek restoration with a boardwalk, providing access to the public and hospital users.

A project such as this improved water quality, improved fish and wildlife habitat, increased public access and education for health purposes, and increased flood prevention.<sup>(5)</sup>

## Partnerships

Methodist Hospital approached Minnehaha Creek Watershed District (MCWD) with a permit application for its new facility, and aligned goals led to this project vision.

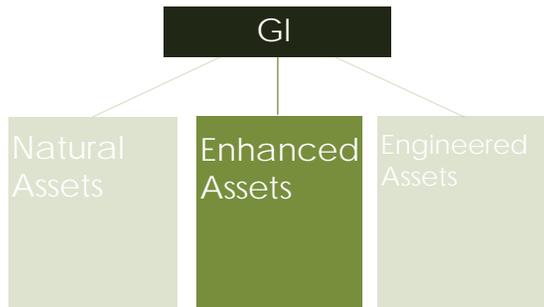
A collaboration between Park Nicollet Health Services, MCWD, and the City of St. Louis Park.

The project costs \$1,092,328 and funding was shared by Park Nicollet and MCWD.<sup>(5)</sup>

## Stewardship

Being a naturalized space it is mostly self-regulating. Some vegetation maintenance occurs sporadically, including removal of invasive and diseased trees and re-planting native tree and shrub species.

## 2. Green Infrastructure: Enhanced Assets



Enhanced assets generally refers to those that have been designed to mimic natural assets and often still include natural elements and processes. For example, a rain garden in a sense mimics a wetland in both design and function and is mostly natural elements, it may even have some of the same species planted.<sup>(1)</sup>

### Enhanced Assets Applicable For Biodiversity at Fraser Health Sites:

Stormwater Ponds,  
Rain Gardens,  
Pollinator Gardens,  
Sensory Gardens,  
Healing Gardens,  
Indigenous Healing / Medicine Gardens



## 2.1 Stormwater Ponds/ Constructed Wetlands

Stormwater ponds are used as a stormwater management strategy. They are engineered wetlands incorporating shallow water and vegetation.<sup>(6)</sup>

These systems mimic the functioning of a natural wetland system and although host less diversity than a naturally occurring ecosystem, they still provide habitat for a variety of flora and fauna.

### Diagram

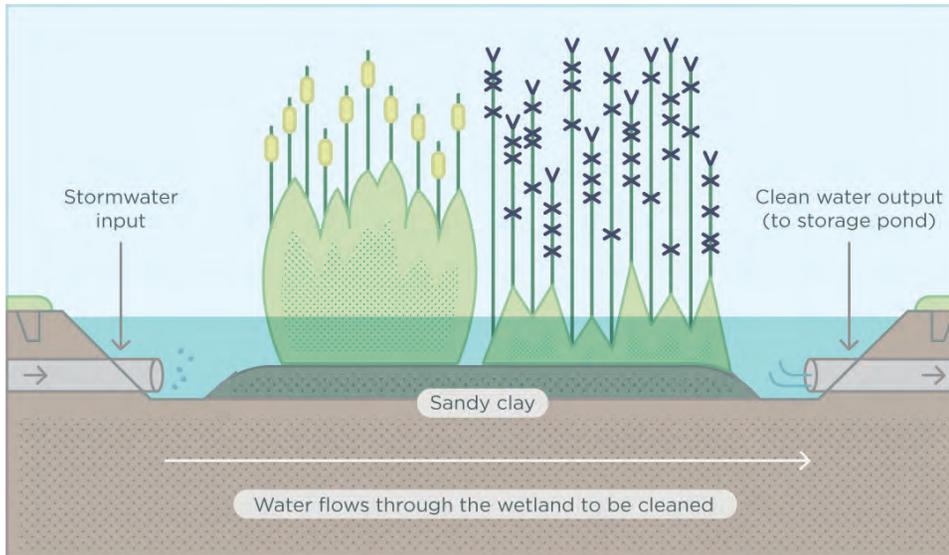


Image: <https://urbanwater.melbourne.vic.gov.au/industry/treatment-types/constructed-wetlands/>

### Maintenance Considerations /Tips

Requires engineer's design and implementation.  
Regular weeding especially in early plant establishment.  
Monitoring and removing invasive species.  
Monitoring drains and clearing of debris.

### Local Resources

#### General Info

City of Vancouver. <https://vancouver.ca/files/cov/integrated-stormwater-management-best-practice-toolkit-volume-2.pdf>

#### Consultancy / Construction

Envirowest. <https://www.envirowest.ca/design-construction/>

### Functionality

#### Best

- Water Quality Treatment
- Biodiversity Benefits

#### Good

- Aesthetic Benefits
- Water Infiltration / Retention

### Costs

#### Best

- Longevity

#### Good

- Construction Costs

#### Limited Benefit

- Land Cost
- Maintenance Cost

# Case Study: Stormwater Ponds/ Constructed Wetlands

Southmead Hospital, Bristol, UK



Image: North Bristol NHS Trust

The hospital was designed with 4,900m<sup>2</sup> of attenuation ponds. These are permanent wetland features, fed by runoff from the car parks which passes through bioswales to clean it before it flows into the reed-filled ponds.

The ponds are an important wildlife habitat, and biodiversity surveys have revealed high numbers of invertebrates living here. Southmead encourages patients, staff and visitors to engage with these blue spaces.<sup>(7), (8)</sup>

Partnerships

This was a joint partnership between National Health Services (NHS) and Southmead Hospital



Image:Southmead Hospital Explorer Map

Stewardship

Ongoing monitoring and management of the sustainable drainage systems would be required, likely by hospital landscaping staff.

## 2.2 Rain Gardens

Rain gardens are a garden intended to slow water runoff. They capture and infiltrate water that typically would flow quickly over other manicured landscape types, such as lawns or paved areas.

Their main purpose is to aid in stormwater management including reducing flooding and removing water pollutants, although they have many other benefits.<sup>(6)</sup>

### Diagram

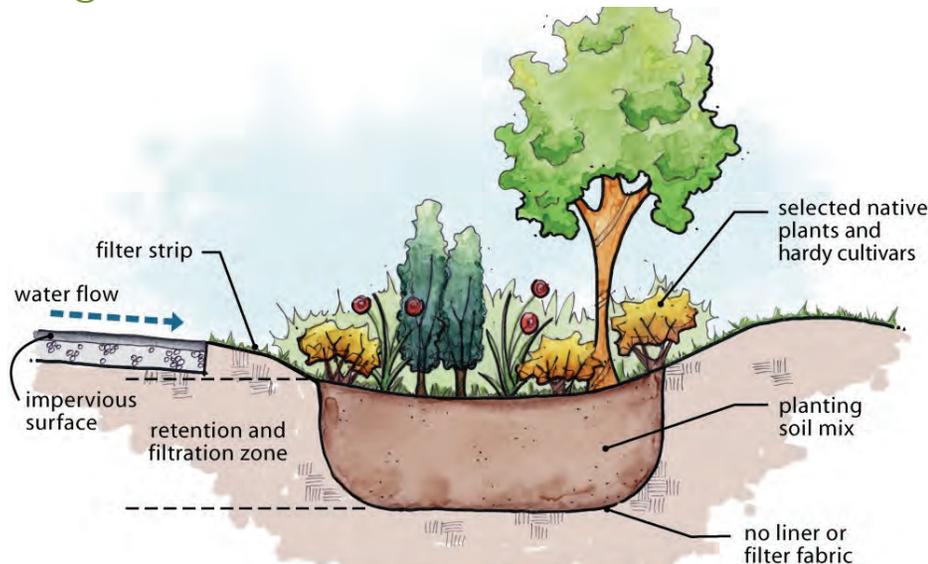


Image Credit: Snohomish Conservation District  
<https://snohomishcd.org/sound-homes-resources/2018/5/1/maintenance-ideas-for-rain-gardens-and-bioretention-facilities>

### Maintenance Considerations /Tips

May require expert design if overflow pipes and additional drainage infrastructure is required for the amount of flow. Regular weeding and watering in droughts and during early plant establishment. Monitoring drains and clearing of debris.

### Local Resources

#### General Info

City of Vancouver. <https://vancouver.ca/files/cov/integrated-stormwater-management-best-practice-toolkit-volume-2.pdf>

<https://vancouver.ca/home-property-development/green-rain-water-infrastructure-design-resources.aspx>

#### Consultancy / Construction

<https://atconsulting.ca/blog/rain-gardens-and-bioswales>

### Functionality

#### Best

- Water Quality Treatment
- Aesthetic Benefits

#### Good

- Biodiversity Benefits
- Water Infiltration / Retention
- Public Education and Cultural Benefits

### Costs

#### Best

- Land Cost

#### Good

- Construction Costs
- Longevity
- Maintenance Cost

# Case Study: Rain Gardens Healthcare

## Gloucestershire Royal Hospital



Image: Gloucestershire Wildlife Trust

Rain gardens are often at ground level capturing runoff, but they can also be designed to capture downspout roof runoff.

In the case of the Gloucestershire Royal Hospital a large raised planter acts as a small, but mighty rain garden. This garden can capture 800 liters of water and contributes to the prevention of local flooding.<sup>(9)</sup>

## Partnerships

This was installed as part of the Gloucester and Cheltenham Waterscapes project, run by Gloucestershire Wildlife Trust and funded by RSA Insurance.

These organizations are investing in nature-based interventions to help limit the impact of flooding on local habitats and local communities.<sup>(9)</sup>

## Stewardship

This is a small scale down-spout rain garden and will be maintained by hospital maintenance staff.

## 2.3 Pollinator Gardens

Pollinator gardens are gardens that have plants selected specifically to benefit pollinators. These are best when there are diverse flower colours and shapes to serve the many different types of pollinator species. Pollinator gardens can be all native species or include beneficial non-native and ornamental plants.<sup>(10)</sup>

### Diagram

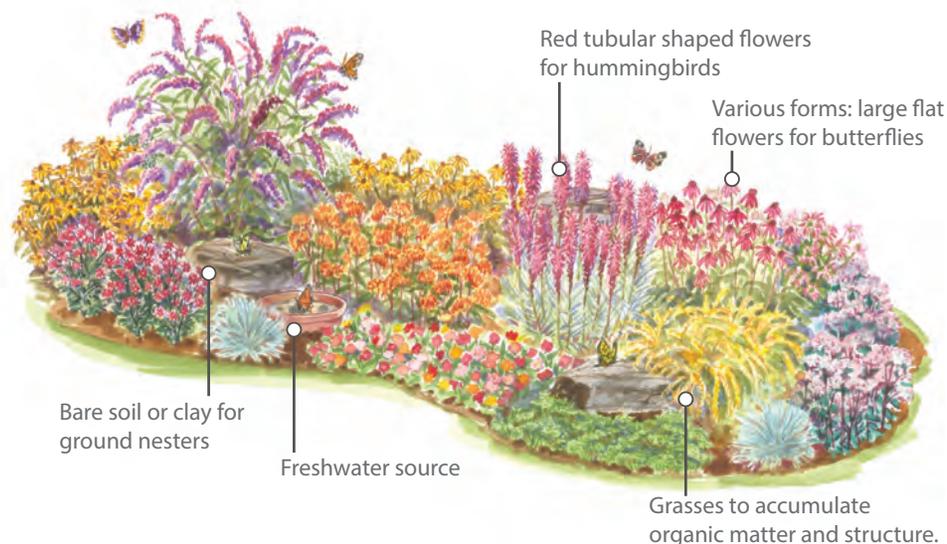


Image: Illustration by Mavis Augustine Torke

### Maintenance Considerations /Tips

Requires minimal expertise to install.  
Good plant selection is key to a successful pollinator garden.  
Regular weeding especially in early plant establishment.  
Could be a drought tolerant design for minimal watering.

### Local Resources

#### General Info / Plant Selection

NAPPC and Pollinator Partnership Canada. <https://pollinatorpartnership.ca/assets/generalFiles/LowerMainland-2017.pdf>

Simon Fraser University. Bee Info Sheet. [https://www.sfu.ca/content/dam/sfu/people/eelle/elle\\_bee\\_info/Bees\\_and\\_Gardens.pdf](https://www.sfu.ca/content/dam/sfu/people/eelle/elle_bee_info/Bees_and_Gardens.pdf)

Vancouver Bee Project. <https://vancouverbeeproject.org/blog/supporting-wild-bees-with-native-plants-a-guide-from-the-pollinator-forage-list>

### Functionality

#### Best

- Biodiversity Benefits
- Aesthetic Benefits

#### Good

- Public Education and Cultural Benefits

### Costs

#### Best

- Land Costs
- Construction Costs

#### Good

- Maintenance Cost
- Longevity

# Case Study: Pollinator Gardens

Groves Memorial Community Hospital  
Elora, Ontario



Image: Elora and Salem Horticultural Society

A local agricultural society funds environmental projects in the community. The new pollinator gardens constructed in 2021 are connected to an existing healing garden and a community trail.

The design is intended to support insect diversity which in turn will support the gardens and local crops.<sup>(11)</sup>

## Partnerships

Grand River Agricultural Society (GRA)  
Elora and Salem Horticultural Society  
Hospital Foundation

The GRA raised funds to create gardens at the hospital including healing gardens and the pollinator gardens.<sup>(11)</sup>

## Stewardship

The pollinator gardens are divided into 14 plots that are managed by volunteers from the Elora and Salem Horticultural Society.

## 2.4 Sensory Gardens

Sensory gardens may be considered one type of a therapeutic garden. They have a focus on stimulating the senses such as sight, smell, touch, sound, and even taste. Thoughtful plant selection can benefit local insects and wildlife while also providing an engaging and interactive landscape for people.<sup>(12)</sup>

### Diagram



Image Credit: City of Oklahoma & OKC Parks. Will Rogers Sensory Gardens.

### Maintenance Considerations /Tips

Requires thoughtful design and minimal expertise to install. Regular weeding especially in early plant establishment. Could be designed to be drought tolerant.

### Local Resources

#### General Info

<https://rootinnature.ca/guide-to-sensory-plants-their-therapeutic-benefits/>

#### Consultancy

Local nurseries and plant experts. <https://natsnursery.com/>  
<https://www.artsnursery.com/service/landscape-consultation>

### Functionality

#### Best

- Aesthetic Benefits
- Health Benefits

#### Good

- Biodiversity Benefits
- \*\*\*Highly variable by design.

### Costs

#### Best

- Land Cost

#### Good

- Construction Costs
- Maintenance Costs

# Case Study: Sensory Gardens

Aldeburgh Hospital, London, UK



Image by Lucy Heaps

A sensory garden was created at a hospital with the focus of stimulating the senses especially for dementia patients. These gardens have elements that allow users to engage with sight, smell, touch, and especially, sound. Featuring musical instruments all throughout the space.

In addition to the health benefits of this space, plantings provide pollinator habitat and refuge for birds and other wildlife.<sup>(13)</sup>

## Partnerships

The Volunteer Garden Team at the hospital was able to initiate the project in consultation with National Health Services (NHS).

The garden was built by a team from Roger Gladwell Landscapes and received a gold for the National Landscaping Design Award.

It was largely funded by CPS Building Services.<sup>(14)</sup>

## Stewardship

All the planting was done by the hospital's own volunteer garden team who maintain the space weekly.

## 2.5 Healing Gardens

A healing garden can be defined in many different ways and is often considered another type of a therapeutic garden. For the purposes of this document it is a garden designed with restorative and calming properties.<sup>(12)</sup>

It may be situated in a quiet place intended to reduce stress and could include lush plantings, as well as a water feature of some kind, either natural or man-made.

### Diagram

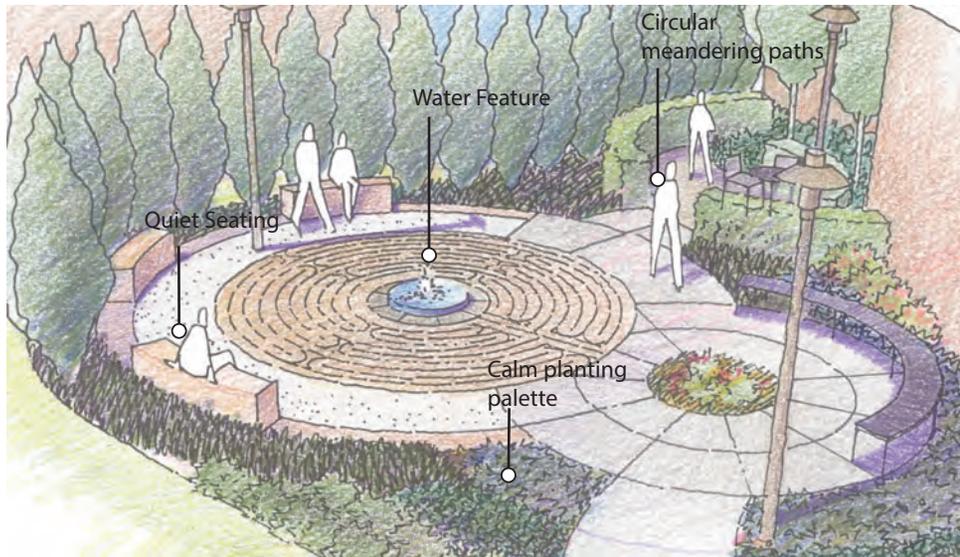


Image Credit: North Colorado Medical Centre, Kemme Healing Garden.  
<https://www.slideshare.net/studio-insite/the-power-of-healing-gardens#11>

### Maintenance Considerations /Tips

Requires thoughtful goals and design. Minimal expertise to install depending on complexity of water features or hard-scapes. Regular weeding.  
Could have a drought tolerant design or smart irrigation.

### Resources

#### General Info

Marcus, C. C., & Sachs, N. A. (2013). <https://pubmed.ncbi.nlm.nih.gov/25303434/>

<https://www.ecotherapyheals.com/types-of-therapeutic-gardens/>

### Functionality

#### Best

- Health Benefits
- Aesthetic Benefits

#### Good

- Biodiversity Benefits
- \*\*\*Highly variable by design.

### Costs

#### Best

- Land Cost

#### Good

- Construction Costs
- Maintenance Costs

# Case Study: Healing Gardens

Delta Hospital, BC.



The Delta Hospital has a healing garden that sits at the heart of the building in a courtyard.

This garden features a loop of paved walkway, raised beds and a water feature. The calm planting palette and shady spots to rest allow for a peaceful retreat for patients, visitors, and staff. <sup>(15)</sup>

## Partnerships

A joint project by the Delta Hospital Foundation, in partnership with the Rotary Clubs of Ladner and Tsawwassen. <sup>(15)</sup>

## Stewardship

The garden is largely maintained by a volunteer garden club, although some larger or more technical maintenance such as plumbing for the water feature are handled by the Facilities and Maintenance staff.

## 2.6 Therapeutic Gardens (Horticultural Therapy)

A therapeutic garden in this document mostly refers to one that is accessible and used by patients, staff, or residents in healthcare in order to benefit from actively gardening. A therapeutic garden may include raised beds so that they are wheelchair accessible and have associated programming.<sup>(12)</sup>

### Diagram



Image : Katie McPartlin

### Maintenance Considerations /Tips

Requires thoughtful design and minimal expertise to install. May require more internal support and initiatives, such as gardening therapy programs, or adopt-a-bed programs.

### Local Resources

#### General Info

<https://www.develop.bc.ca/enabled-gardens/>

Marcus, C. C., & Sachs, N. A. (2013). <https://pubmed.ncbi.nlm.nih.gov/25303434/>

### Functionality

#### Best

- Health Benefits
- Public Education and Cultural benefits

#### Good

- Biodiversity Benefits
- \*\*\* Highly variable by design.

### Costs

#### Best

- Land Cost

#### Good

- Construction Costs
- Maintenance Costs

# Case Study: Therapeutic Gardens (Horticultural Therapy)

## Mountain View Manor, Delta BC



The enclosed patio space at Mountain View Manor long-term care home features raised garden beds and a small greenhouse.

Residents are encouraged to interact with the beds and garden if able. The sedum and drought tolerant plants ensure plant health during hot summers and create interest for residents. <sup>(16)</sup>

## Partnerships

A collaborative project with Mountain View Manor and South Delta Garden Club. <sup>(16)</sup>

## Stewardship

The South Delta Garden Club maintains this space along with the occasional help from residents. Facilities and Maintenance Operations will aid with some maintenance, such as the installation of shade canopies in the summer.

## 2.7 Indigenous Healing / Medicine Gardens

The majority of First Nations people in BC live in urban areas. However, westernized health services do not always enable access to traditional healing.<sup>(4)</sup> Healing gardens or medicine gardens are a way to increase access to culturally significant plants in health care settings.

There are a number of precedents of indigenous initiated and led projects in Canada and BC. These gardens can vary greatly in design and plant selection depending on the goals and desires set on a project by project basis.

Engaging with local first nations and participation of indigenous residents, patients, staff and community partners is at the core of these projects.<sup>(17)</sup>

### Local Resources

#### General Info

<https://indigenous.landfood.ubc.ca/the-medicine-collective/>  
<https://sprucelab.ca/healing>

#### Consultancy

<https://firelight.ca/what-we-do/core-services/indigenous-health>  
<https://www.fnha.ca/>

### Functionality

#### Best

- Health Benefits
- Public Education and Cultural benefits

\*\*\*Benefits will depend on the design of a project, although often having an emphasis on native medicinal plants means that there is potential to greatly benefit biodiversity and provide other ecological benefits to the area.

xwǰícəsəm Garden.  
UBC students and community members blend dried medicine plants for tea in a workshop.

Image: <https://ubc-farm.ubc.ca/learn/indigenous-initiatives/>



### Maintenance Considerations /Tips

The use of native species often means that plants are well adjusted to our climate and may reduce the need for formal mowing and pruning or regular watering.

# Case Study: Indigenous Healing Gardens

## x<sup>w</sup>ćíćəsəm Garden



The x<sup>w</sup>ćíćəsəm Garden was established in 2007 at the UBC farm on the traditional and unceded territory of the musqueam people.

It has an emphasis on teaching, community engagement, and research related to Indigenous knowledge. <sup>(17)</sup>

## Partnerships

The garden is run through the Indigenous Research Partnerships within University of British Columbia's Faculty of Land and Food Systems.

There are a few major programs supported here. The Medicine Collective, leads medicine-making workshops and walks in the Garden. Additionally the Culturally Relevant Urban Wellness program creates learning experiences for indigenous and recent immigrant youth at the gardens.

First Nations House of Learning and the Vancouver Native Health Society are also active partners. <sup>(17)</sup>

## Stewardship

Many people and partners are involved with the care of this space including staff of the gardens and Indigenous Research Partnership, volunteers, and community members.

# Case Study: Indigenous Healing Gardens

## Ajax Pickering Hospital, Ontario



Image: Town of Ajax. <https://www.ajax->

An Indigenous Community & Healing Garden was designed and installed in 2022 at the Ajax and Pickering Hospital. The design and plant selection integrated components of indigenous history and learnings.

“The garden provides a space of relief and recreation for hospital staff, patients, volunteers and community members as well as enhance our connection to the indigenous peoples of the Mississaugas of Scugog Island.”- Ajax Pickering Hospital

## Partnerships

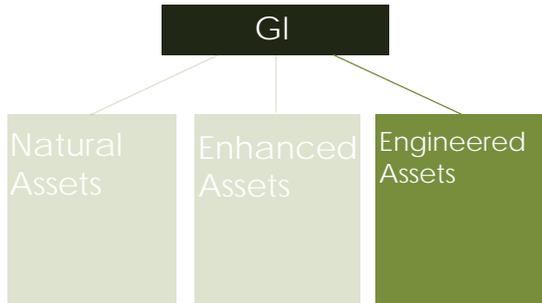
This garden was designed by an Indigenous consultancy and garden design company, Miinikaan Innovation & Design.

We Grow Foods, a local food security non profit, also aided in the development of the project at this hospital site.

## Stewardship

We Grow Foods non-profit along with community volunteers help to maintain this space and cultivate food for donations to local food kitchens.

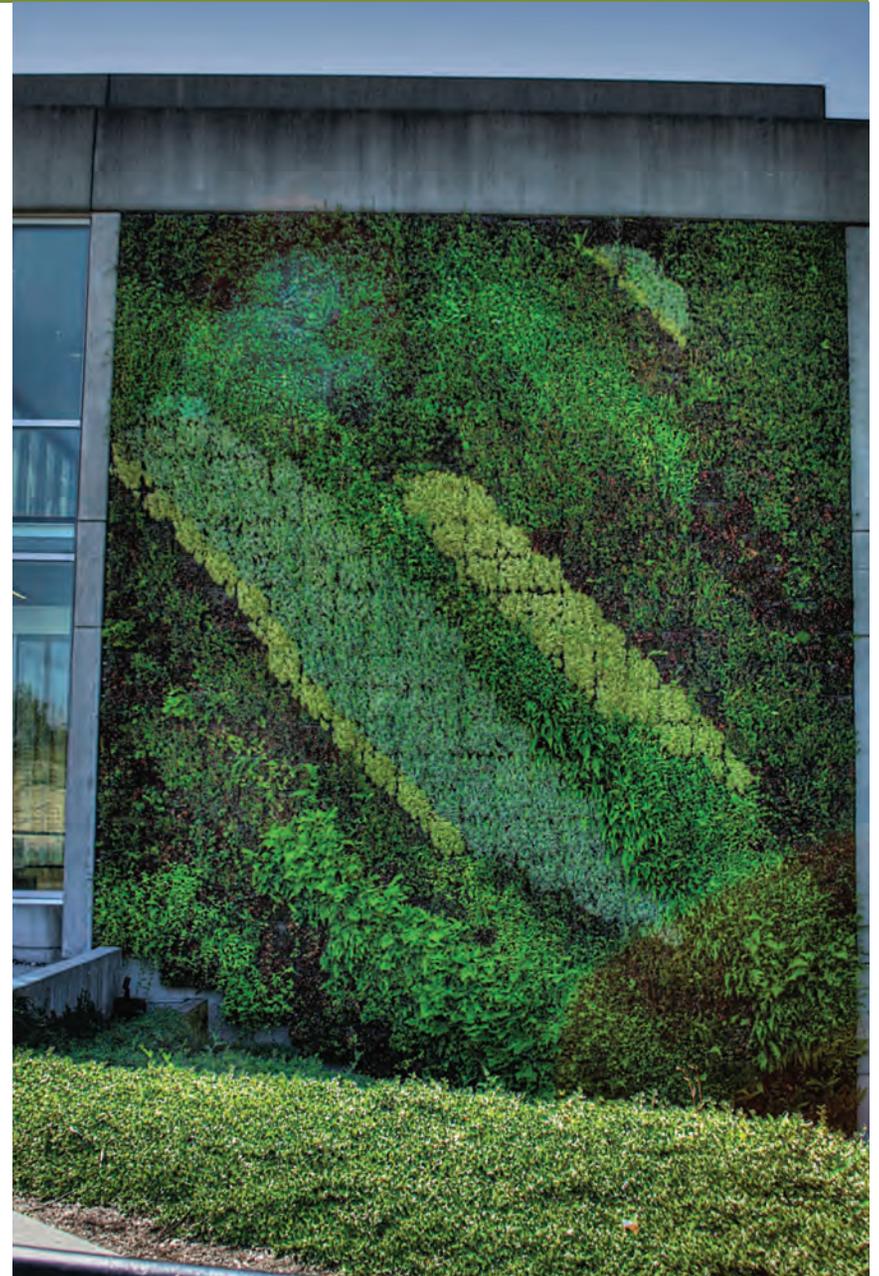
### 3. Green Infrastructure: Engineered Assets



Engineered assets differ from enhanced assets in that they typically only mimic the function of natural assets but isn't something found in nature. For example, a rain barrel mimics the function of a wetland in that it stores rainwater, but it is an entirely man-made structure.<sup>(1)</sup>

Engineered Assets Applicable For Biodiversity at Fraser Health Sites:

- Green Roofs
- Green Walls



# 3.1 Greenroofs

Green roofs are planted areas added to the roof assembly, often plants and soils come in premade cells. Green roofs can be a great way to provide pollinator and bird habitat and increase the surface area that is able to capture and slow rainwater.

Drought tolerant xeriscaping species are a great option for these spaces.

## Diagram

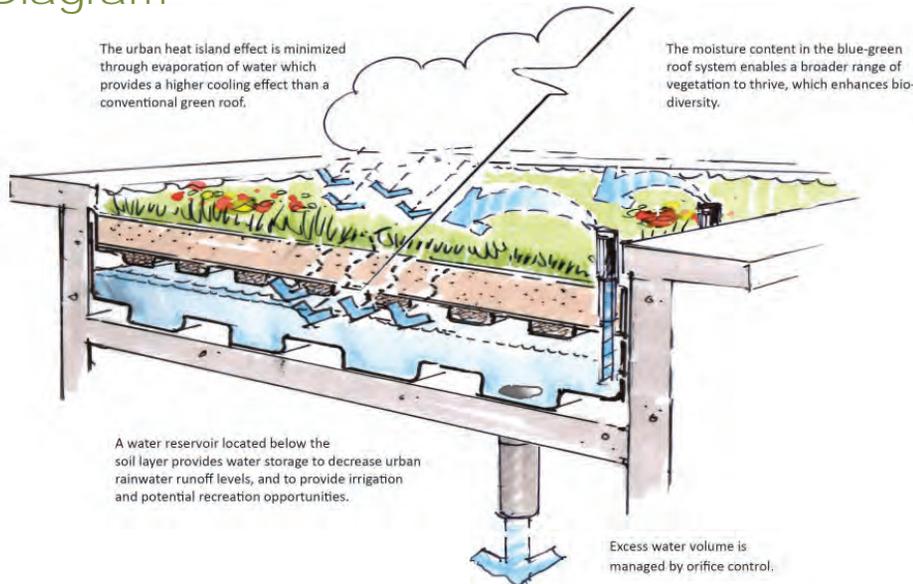


Image: City of Vancouver: <https://vancouver.ca/files/cov/one-water-gri-typologies.pdf>

## Maintenance Considerations /Tips

Requires consultation with engineers and thoughtful design and some expertise to install.  
May require weeding and occasional replacement of plants. Xeriscaping is typically used to avoid irrigation.

## Local Resources

### General Info

The Green Roof Infrastructure Network. <https://grinbc.org/>

### Consultancy / Construction

Nats Nursery. <https://natsnursery.com/live-roof/>

<http://www.bcgreenroof.ca/>

## Functionality

### Best

- Aesthetic Benefits

### Good

- Biodiversity Benefits
- Water Infiltration / Retention
- Public Education and Cultural benefits

## Costs

### Best

- Land Cost

### Limited Benefit

- Maintenance Costs
- Construction Costs

# Case Study: Green roofs

## Sharp Memorial Hospital, California, US



A 5000 square foot green roof was completed in 2010 at the Sharp Memorial Hospital. Patients mostly enjoy this view from above and are often pleased if they discover it represents the first few bars of Beethoven's "Ode to Joy".

The planting is a mix of raised planters, trees, and ground covers. The roofing assembly was built up and planted with mostly sedum tiles and other drought tolerant plant plugs.

It has reduced stormwater runoff, provided pollinator and bird habitat, as well as aided in the climate control of the building and exterior environment. <sup>(19)</sup>

## Partnerships

The hospital initiated the project and many people were involved in its installation.

Schmidt Design Group designed the garden and worked closely with structural engineers, green roof plant experts, and landscapers.

Greenscaped Buildings was the company who installed the project and Rooflite is the plant green roof company that provided the plants in their modular forms. <sup>(19)</sup>

## Stewardship

This is likely maintained by hospital maintenance staff or hired landscapers. It would require some expertise or prior knowledge of the project. Due to the drought tolerant species selection it should be a long-lasting design, although may require occasional renovations.

## 3.2 Green walls

Green walls vary by design, but generally describe vertical vegetative growth up the side of a building. Often pockets or shelves of plants connected to a pump irrigation system are installed. When done successfully they can add another dimension of interest.

An easy alternative to create verticality along buildings are vining species. These help shade the buildings, reducing heating and cooling energy.

### Diagram

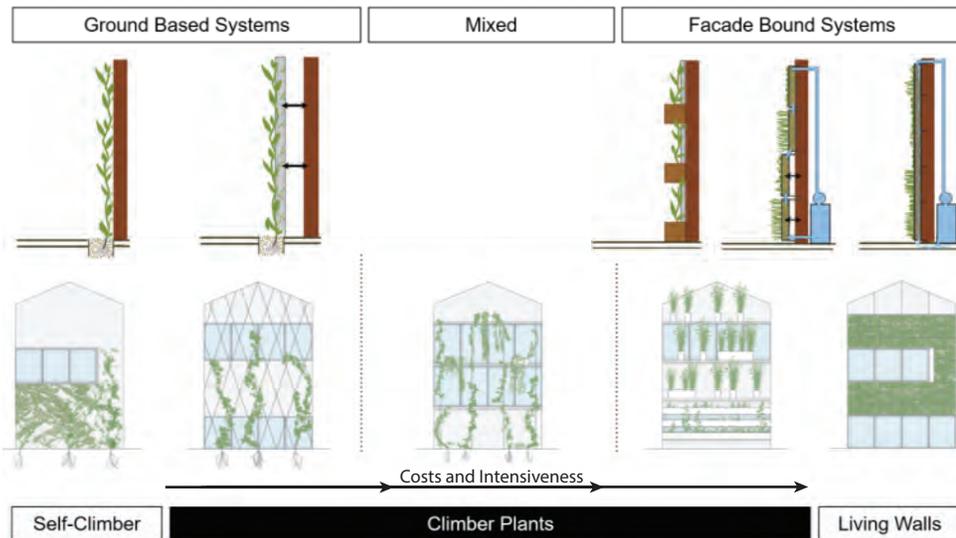


Image Credit: [www.greenrooftechology.com](http://www.greenrooftechology.com)  
<https://www.tensile.com.au/green-facade-types-the-differences-explained/>

### Maintenance Considerations /Tips

Expertise for design and construction required.  
Some upkeep of the structure and plant replacement or care is required and typically maintained by the company who installed the infrastructure.

### Local Resources

#### General Info

<https://citystudiovancouver.com/wp-content/uploads/2018/07/GCAP-2.0-Final-Report-Green-Buildings-Goal-3.pdf>

#### Consultancy / Construction

GSky Versa XT Installation. <https://architek.com/vertical-gardens/>

### Functionality

#### Best

- Aesthetic Benefits

#### Good

- Biodiversity Benefits
- \*\*\* Highly variable by design.

### Costs

#### Best

- Land Cost

#### Limited Benefit

- Construction Costs
- Maintenance Costs

# Case Study: Green walls

## St. Luke's Hospital Living Wall, Oxford UK



St. Luke's Hospital is an independent care home that provide both long and short term care.

The 88m<sup>2</sup> green wall sits on the Southeast facade nearest the main entrance and parking. This location was strategic to maximize the air purification potential of the project. Mostly native and some cultivars of plant species were selected based on their ability to remove air pollutants, provide pollinator blooms and provide year round interest.<sup>(20)</sup>

## Partnerships

Biotecture designed and installed the living wall as part of a building renovation with Oxford Architects.

The wall was planted and grown off site to maximize plant success rate during delivery and installation. The planting helps satisfy BREEAM eco building requirements.<sup>(20)</sup>

## Stewardship

The living wall is maintained by biotecture as replacing plants and irrigation pumps would require specific expertise.

## 4. Habitat Structures and Features

Habitat structures are often installed where habitat features are lacking, especially in urban areas. They can also enhance existing natural habitats.

These structures can support various species by providing opportunities for nesting, roosting, perching, rearing, basking, and protection from predators or weather.<sup>(4)</sup>



Image: Kaitlin McPartlin

# 4.1 Wildlife Habitat Features

Habitat features provide essential structural complexity to an ecosystem, providing opportunities for the large variety of BC wildlife to find shelter, nest, or hibernate. <sup>(4)</sup>

This complexity often develops overtime with the help of natural processes such as decay. For example dead standing trees can become an essential habitat component, often called a wildlife tree or a snag. These dead trees are teeming with life, from fungi to invertebrates, woodpeckers, and cavity nesting birds.

## Snags



## Large Woody Debris



## Leaf Litter



## Brush Piles



## Maintenance Considerations /Tips

These elements are most relevant for sites that may be already managing natural assets, such as forests. Habitat features like these can also be recreated in more naturalized planted areas or integrated into garden maintenance, for example leaving leaf litter overwinter is one way to provide seasonal habitat features in an traditional garden.

## 4.2 Habitat Structures

Habitat structures refers to built forms that offer refuge for wildlife. These can vary vastly depending on the targeted species or group of species. <sup>(4)</sup>

### Nest Boxes

Nest boxes are often wooden built structures that are designed to host specific bird species during the nesting season. Over winter these structures can also double as roosting habitat to shelter small birds from the cold.

Designs vary widely depending on species. They most often vary in placement and orientation, hole size, and height.

Nest boxes are really significant structures for species that are endangered or have lost significant portions of their nesting habitat, such as aerial insectivores including barn swallows.

Nest boxes and bird feeders can act as cognitive stimulation and enhance sound sensory in health care settings.

### Maintenance Considerations /Tips

Require some research behind the goals and design in order serve it's intended function.

Some structures require upkeep and regular (often annual) cleaning to prevent the spread of disease or bacteria amongst birds. Nest monitoring is beneficial to track usage.



Image Peter Ward. McCleery Golf Course Vancouver. <https://naturevancouver.ca/tree-swallow-nesting-box-program/>

### Local Resources

#### General Info and Construction

<https://nestwatch.org/learn/all-about-birdhouses/>  
<https://wdfw.wa.gov/species-habitats/living/wood-working-projects>

<https://www.sialis.org/nestboxguide/>

#### Consultation and Construction

Cascade Bird Box Team. <https://naturevancouver.ca/cascade-bird-box-team-2022-report/>

## Bee Condos

Bee condos or bug hotels are structures with many drilled or natural holes. These are often occupied by bugs for nests or for overwintering.

Many different species of insects utilize these structures including mason bees, and hairy belly bees.

The presence of these insects around gardens can greatly support plant pollination, reduce pest insect populations and provide provisioning for wildlife further up the food chain.

The design of these also vary depending on target species, the hole size is particularly important.

## Maintenance Considerations /Tips

Easy design and construction.

Seasonal cleaning to prevent the spread of disease and make space for new insects.

Incorporating natural habitat elements in gardens such as leaf litter, described in the last section, is the most effective way to support nesting or overwintering insects.



Image Lucy Heaps, Alderburg Hospital UK



Image Katie McPartlin, Burrard Slopes Park

## Local Resources

### General Info

[https://www.sfu.ca/content/dam/sfu/people/eelle/elle\\_bee\\_info/Bees\\_and\\_Gardens.pdf](https://www.sfu.ca/content/dam/sfu/people/eelle/elle_bee_info/Bees_and_Gardens.pdf)

### Construction

<https://www.pollinator.org/pollinator.org/assets/generalFiles/Build-a-Bee-Condo-2020.pdf>

# Definitions

## Biodiversity

Refers to the variety of life on earth, this includes species and ecosystems and their ecological processes. This document generally refers to species diversity.

## Ecosystem Services

These are known benefits that people gain from ecosystems or green infrastructure including regulating provisioning and social or cultural benefits. For example, carbon sequestration is a regulating ecosystem services that trees provide, and people benefit from.

## Green Infrastructure

Natural and constructed features in urban environments that can provide ecosystem services.

### Natural Assets

Are a subset of green infrastructure and refers to natural stores of resources or naturally occurring ecosystems. The 'asset' component implies that they provide ecosystem services or benefits to people in some capacity.

### Enhanced Assets

Are generally those that have been designed to mimic natural assets and often still include natural elements and processes. For example, a rain garden in a sense mimics a wetland in both design and function and is mostly natural elements, it may even have some of the species planted.

### Engineered Assets

These differ from enhanced assets in that they typically only mimic the function of natural assets but isn't something found in nature. For example, a rain barrel mimics the function of a wetland in that it stores rainwater.

## Functionality and Costs Evaluation

The functionality and cost assessment was based off the methods used in the Best Management Practice Toolkit for rainwater by the City of Vancouver.<sup>(6)</sup> The categories used to evaluate relative functional and cost benefits are as follows.

### Functionality

- Biodiversity Benefits
- Water Infiltration / Retention
- Water Quality Treatment
- Public Education and Cultural Benefits
- Aesthetic benefits

### Costs

- Land Cost
- Longevity
- Maintenance cost
- Construction cost

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