



CLIMATE 2050 Roadmap

Nature & Ecosystems

A pathway to storing carbon and building a resilient future
with Nature and Ecosystems in Metro Vancouver

April 2023

FRONT COVER: FOREST

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April 2023

Metro Vancouver acknowledges that the region’s residents live, work, and learn on the shared territories of many Indigenous peoples, including 10 local First Nations: ǰíǰǰ (Katzie), ǰʷǰ:ńǰǰ (Kwantlen), kʷikʷǰǰ (Kwikwetlem), máthxwi (Matsqui), xʷmǰθkʷǰǰ (Musqueam), ǰǰǰǰ (Qayqayt), se'mya'me (Semiahmoo), Sǰǰǰǰǰǰǰǰ (Squamish), scǰǰǰǰǰǰǰǰ (Tsawwassen), and sǰǰǰǰǰǰǰǰ (Tsleil-Waututh).

Metro Vancouver respects the diverse and distinct histories, languages, and cultures of First Nations, Métis, and Inuit, which collectively enrich our lives and the region.



Metro Vancouver

Metro Vancouver is a federation of 21 municipalities, one electoral area, and one treaty First Nation that collaboratively plans for and delivers regional-scale services. Metro Vancouver's core utility services include drinking water, sewage treatment, and solid waste management, along with regional services like regional parks, affordable housing, regional land use planning, and air quality and climate action that help keep the region one of the most livable in the world.

Mission

Metro Vancouver's mission is framed around three broad roles:

1. Serve as a Regional Federation

Serve as the main political forum for discussion of significant community issues at the regional level, and facilitate the collaboration of members in delivering the services best provided at the regional level.

2. Deliver Core Services

Provide regional utility services related to drinking water, liquid waste and solid waste to members. Provide regional services, including parks and affordable housing, directly to residents and act as the local government for Electoral Area A.

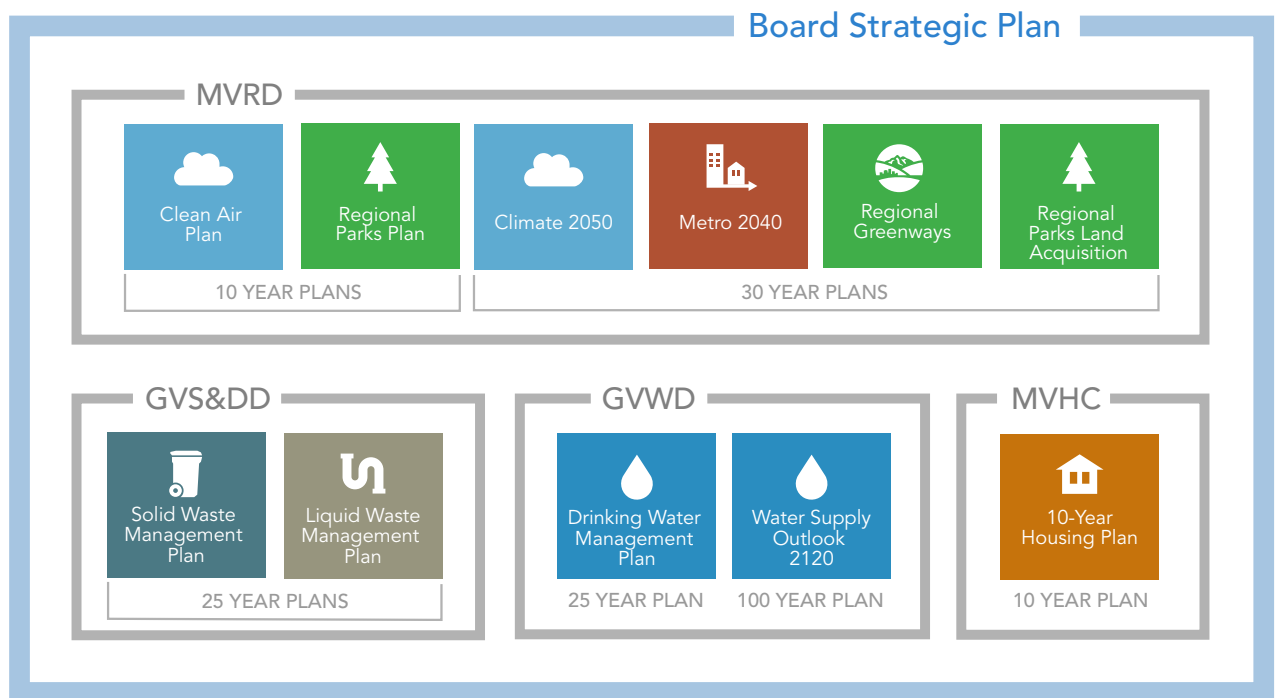
3. Plan for the Region

Carry out planning and regulatory responsibilities related to the three utility services as well as air quality, regional planning, regional parks, Electoral Area A, affordable housing, labour relations, regional economic prosperity, and regional emergency management.



Building a Resilient Region

Building the resilience of the region is at the heart of Metro Vancouver’s work. Each of Metro Vancouver’s regional plans and strategies adopts a vision, guiding principles, goals, strategies, actions and key performance measures that will support a more resilient, low carbon and equitable future. Metro Vancouver’s interconnected plans and strategies are guided by the *Board Strategic Plan*, which provides strategic direction for each of Metro Vancouver’s legislated areas of responsibility and the *Long-Term Financial Plan* which projects total expenditures for capital projects and operations that sustain important regional services and infrastructure. Together these documents outline Metro Vancouver’s policy commitments and specific contributions to achieving a resilient region.



Adopted by the Metro Vancouver Board in 2018, the *Ecological Health Framework* encapsulates Metro Vancouver’s collective efforts around ecological health and provides guiding principles, goals, and strategies to help achieve the vision of “a beautiful, healthy, and resilient environment for current and future generations”. To help guide corporate actions, the Framework set three high-level goals: 1) build ecological resilience and minimize impacts; 2) protect natural areas and conserve ecosystem services; and 3) nurture nature within communities. The *Climate 2050 Nature and Ecosystems Roadmap* complements and builds on the *Ecological Health Framework* by identifying additional corporate and regional actions to maximize carbon storage, resilience, and other critical ecosystem services.

Metro Vancouver's Roles and Responsibilities for Climate Action

The actions to achieve carbon neutrality and building a more resilient region will depend on the collaborative efforts of many players in the region as well as the federal and provincial government. However, Metro Vancouver has some unique and important roles and responsibilities for advancing climate action.

- Under the *Environmental Management Act*, Metro Vancouver has the delegated authority to provide the service of air pollution control and air quality management and may, by bylaw, prohibit, regulate and otherwise control and prevent the discharge of air contaminants, including greenhouse gases.
- Through the regional growth strategy, Metro Vancouver, with its members, protects important lands and plans for compact, complete communities that are foundational to enabling a carbon neutral, resilient region.
- As part of delivering its core services, Metro Vancouver also generates and uses clean, renewable energy from its facilities and is working to ensure core regional services and infrastructure are prepared for and resilient to climate change.
- Invest Vancouver is Metro Vancouver's economic development leadership service with the vision of a dynamic and resilient regional economy that delivers prosperity for all. It aims to foster greater regional collaboration on economic development issues, to advise leaders on sound economic policy and strategy, and to brand the region and its key industries to a global audience with the intention of attracting strategic investment. Invest Vancouver focuses on key export oriented industries in which the region has a productive advantage. This includes many aspects of the green economy, including clean technology, renewable energy and clean transportation.
- In its role as a regional forum, Metro Vancouver builds and facilitates collaborative processes which engage the public and build partnerships to address significant regional issues like climate change. As part of this role, Metro Vancouver coordinates with and advocates on behalf of its member jurisdictions to other governments and partners on greenhouse gas management and climate change adaptation initiatives.

These roles are necessary but not sufficient to achieve our goals of a climate neutral, resilient region. Metro Vancouver will be looking to other orders of government, First Nations and other regional partners to lead and collaborate in the implementation of a number of key actions in the *Climate 2050 Roadmaps*.



The Roadmap at a Glance

Metro Vancouver's ecosystems are vital to the people and wildlife who live here. In both urban and natural areas, these ecosystems have tremendous cultural and spiritual importance, contribute to the region's livability, provide a sense of place, and foster biodiversity. Nature and ecosystems help us address climate change by sequestering carbon annually and storing it over the long-term, while also bolstering our resilience to climate change impacts such as extreme heat and flooding. Nature and ecosystems are themselves at risk of a changing climate, exacerbated by other stressors such as land development and invasive species.

Despite the challenges faced, the region is well-positioned to take action and maintain a healthy environment. By protecting, restoring, and enhancing ecosystems, and connecting them together across the region through a robust green infrastructure network, we can support productive and resilient ecosystems that help us address climate change. Natural asset management — a concept that involves accounting for the benefits nature provides — continues to gain traction across the region. Improving the health and extent of the region's urban forest is another opportunity to take climate action close to where people live and work. Lastly, our collective efforts to address climate change can include nature-based solutions that help address multiple problems, such as biodiversity loss and climate change, simultaneously.

Although there is much work to be done, there are some important actions that can be implemented now to supplement the efforts in other sectors to reach a carbon neutral and resilient region by 2050. It is critical that the actions identified in this Roadmap are implemented rapidly to prevent future ecosystem loss and degradation, and to maximize long term carbon storage, resilience, and other co-benefits. We are not alone in this challenge.



The *Nature and Ecosystems Roadmap* lays out 31 actions for storing carbon and increasing resiliency, organized under the following five strategic areas:

- 1 Protect, Restore, and Enhance the Region's Ecosystems
- 2 Connect Green Infrastructure
- 3 Integrate Natural Assets into Conventional Asset Management and Decision-Making Processes
- 4 Support a Resilient, Robust, and Healthy Urban Forest
- 5 Advance Nature-based Solutions to Climate Change

The actions in this Roadmap demonstrate the importance of working collectively to reach climate objectives, and will complement other regional plans that support healthy and biodiverse ecosystems. Working closely with First Nations, the federal and BC governments, member jurisdictions, and other key partners will be critical to effectively implement the actions in this Roadmap. Together, we can ensure that nature and ecosystems are an integral part of creating a carbon neutral and resilient region.

Incorporating Indigenous Knowledge into Climate Action

The *Nature and Ecosystems Roadmap* emphasizes that a healthy natural environment is vital to the region's response to climate change, as well as the health and well-being of people. Our current decision-making frameworks do not properly recognize the importance of natural systems and operate as if humans are separate from or a higher priority than nature. The *Nature and Ecosystems Roadmap* recognizes that we need to do things differently moving forward.

Since time immemorial, First Nations have been stewards of the region's lands, waters, and air. Practiced and learned for millennia, complex knowledge systems grounded in earth based observation are known collectively as 'Indigenous Knowledge'. The *Declaration on the Rights of Indigenous Peoples Act* (DRIPA) emphasizes Indigenous rights to conserving the environment and protecting Indigenous knowledge.

Indigenous Knowledge systems and Western science may function differently, but these two approaches can be mutually supportive. Bringing these ways of knowing together and combining their strengths requires a commitment to work together to build trust and understanding.

As the Truth and Reconciliation Commission of Canada report states, reconciliation between Indigenous and non-Indigenous Canadians, from an Indigenous perspective, also requires reconciliation with the natural world.

Inspired by the work of the Truth and Reconciliation Commission of Canada, Metro Vancouver is working together with First Nations to strengthen relationships by exploring pathways to reconciliation, such as increased engagement, dialogue, and collaboration.







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Visioning Healthy and Resilient Nature and Ecosystems in 2050

Our vision is that in 2050, Metro Vancouver is a place where the natural environment provides benefits to humans and other species alike, and the relationship between people and nature is more intrinsically known and understood by residents across the region. Indigenous Knowledge of the natural world is respected and honoured and informs decision-making alongside Western science. Nature and ecosystems are recognized for their inherent value as irreplaceable systems, but also for their ability to foster biodiversity, store carbon, and moderate the impacts of climate change. The way we “do business” has undergone a paradigm shift, such that these benefits are recognized and accounted for in decision-making processes. Ecosystems are healthy in natural areas, but also within the communities where people live, work and play. Our region is known globally as a leader in fostering relationships and partnerships - working together to enable the protection, enhancement, restoration, and connection of ecosystems, and implementing nature-based solutions to support biodiversity, moderate the impacts of climate change, and store carbon over the long-term.

Climate 2050 Nature and Ecosystems Roadmap

A pathway to storing carbon and building a resilient future with Nature and Ecosystems in Metro Vancouver

The Challenge

This Roadmap is about ambitious and necessary protection, enhancement and restoration of our natural environment. It presents a robust plan for this region to maintain a healthy environment that is supported by productive and resilient ecosystems. Nature and ecosystems have the capacity to store carbon and help moderate the impacts of a changing climate, and they provide numerous other benefits; however, these natural systems are themselves at risk due to a changing climate, land development, invasive species, pollution, and other factors. Decisions we make now to protect, restore, enhance, and connect nature and ecosystems across the region will have a lasting impact on the state of the natural environment in the future.

A carbon neutral and resilient region, supported by healthy ecosystems, is the best option for future generations to maintain a good quality of life, beyond 2050. We have to make some significant decisions and investments today or pass them on to future generations at higher cost and consequence. Metro Vancouver and many of its member jurisdictions have committed to ambitious targets and bold leadership to respond to the climate crisis. This plan responds to the global challenge to come together, think big, and act now in this region.

The Connection between Climate and Air Quality

The *Clean Air Plan* is Metro Vancouver's air quality and greenhouse gas management plan. Actions in the Plan will reduce air contaminant emissions and impacts in our region, including greenhouse gases, over the next 10 years. These actions will support the interim target of a 45% reduction in greenhouse gas emissions by 2030, and establish the foundation for the 30-year goal of a carbon neutral region by 2050. The *Clean Air Plan* also addresses air quality targets for the region.

Residents in the region generally experience good air quality, but additional emission reduction actions are needed to continue protecting human health and the environment. Some air contaminants, such as ground-level ozone, can damage plants and reduce vegetation growth, adding to the stress on nature and ecosystems imposed by climate change. As temperatures rise and droughts become more frequent, forests in the Pacific Northwest are at increased risk to wildfires. Wildfires create significant amounts of fine particulate matter, the air contaminant with the greatest air quality-related health impacts in our region. While this topic area is touched on in the *Nature and Ecosystems Roadmap*, response to the air quality impacts of wildfires will be addressed in more detail in the *Human Health and Well-being Roadmap*, as well as the *Clean Air Plan*.

Climate Change Impacts on Nature and Ecosystems

While nature and ecosystems store carbon and help us adapt to climate change impacts, many natural areas and the services they provide are themselves at risk from a changing climate. For example, trees store carbon, cool our streets, and capture and regulate floodwater, but they are less able to provide these benefits if they are suffering from drought and extreme heat.

Many species and ecosystems in the region are being impacted by climate change because they cannot adapt fast enough – for instance, Pacific salmon are affected by warming stream temperatures, stressing fish and increasing vulnerability to disease (see Species Case Study on page 26). Climate change adaptation must be considered when managing ecosystems in urban and natural areas, including the development of best practices supported by current climate science. While specifics are likely to change when new climate change projections are completed and more data becomes available, high-level trends are likely to remain consistent over time. Metro Vancouver would like to combine different sources of knowledge by working with First Nations to understand observed changes in climate and the natural environment.

We can contribute to the region's collective climate resilience by monitoring the extent and health of urban and natural ecosystems, providing space in our communities for nature to adapt and flourish, and considering the natural environment as a critical part of climate action.

The region's nature and ecosystems are, and will continue to be, affected by climate change and associated hazards – these hazards could cause impacts in numerous ways. However, nature and ecosystems can also minimize the impacts of climate change. These relationships are outlined in Table 1 below.

Anticipated impacts to nature and ecosystems from climate change may also affect species important to First Nations for traditional ceremonial use, foods and medicines.



WESTERN RED CEDAR IN A STATE OF DECLINE IN WEST VANCOUVER (DISTRICT OF WEST VANCOUVER)

Climate change and its associated impacts on ecosystems can also cause feelings of grief and anxiety, negatively impacting mental health and well-being. This issue will be explored in greater detail in the *Human Health and Well-Being Roadmap*.

TABLE 1: CLIMATIC CHANGES AND HAZARDS AND THEIR POTENTIAL IMPACTS ON NATURE AND ECOSYSTEMS

CLIMATIC CHANGES AND HAZARDS	ANTICIPATED IMPACTS TO NATURE AND ECOSYSTEMS	HOW NATURE AND ECOSYSTEMS CAN MINIMIZE IMPACTS
Sea level rise and flooding (coastal and riverine)		
Rising water levels	<ul style="list-style-type: none"> • Shoreline ecosystems will be lost as they are caught between rising waters and hardened shoreline infrastructure (known as coastal squeeze). • Extreme flooding causes structural changes to rivers and shorelines, shifting ecosystems and impacting fish and wildlife. • Flood waters deposit excess sediment over fish habitat, including spawning areas, impacting fish health and populations. • During a flood, toxic substances from low-lying areas (e.g. urban and industrial sites) can be released, damaging ecosystems. 	<ul style="list-style-type: none"> • Natural shorelines reduce the impacts of riverine and coastal flooding by absorbing water and wave energy. They also provide space for ecosystems to adapt and move as water levels rise.
Changing salinity in rivers	<ul style="list-style-type: none"> • Salt water will move further upstream during lower river flows, affecting freshwater aquatic ecosystems. 	
Combined impact of sea level rise, storm surge and coastal flooding	<ul style="list-style-type: none"> • The ecological impacts of coastal storms and flooding are exacerbated by sea level rise. 	<ul style="list-style-type: none"> • Coastal and intertidal ecosystems (such as mudflats and seagrass beds) protect at-risk communities by reducing the impacts of waves and extreme tides, absorbing excess water, and buffering the impacts of coastal storms.
Changing precipitation patterns		
More intense rainfall events	<ul style="list-style-type: none"> • Increased pollutant run-off, turbidity, and erosion, leading to poor water quality and impacts to freshwater and marine ecosystems. • Increased risk of landslides, disrupting wildlife habitat and movement. 	<ul style="list-style-type: none"> • Wetlands, riparian ecosystems and other vegetated areas reduce the impacts of flooding, prevent erosion, and absorb and filter rainwater, reducing the strain on stormwater infrastructure – but in extreme events, natural systems can be overwhelmed.

CLIMATIC CHANGES AND HAZARDS	ANTICIPATED IMPACTS TO NATURE AND ECOSYSTEMS	HOW NATURE AND ECOSYSTEMS CAN MINIMIZE IMPACTS
Longer dry spells in the summer	<ul style="list-style-type: none"> • Drought conditions, combined with higher temperatures, reduce annual tree growth and increase mortality rates. • Warmer waters and less flow during the dry season, combined with an earlier freshet, will stress and limit migration of salmon and other aquatic species. • Drought can stress newly planted restoration areas, increase the risk of fire and disease, and increase the likelihood that trees are blown over during high winds. • Longer and more intense wildfire season, driven by both heat and drought. • Long periods of drought will dry out wetlands by lowering water tables. 	<ul style="list-style-type: none"> • Trees and other vegetation help to retain the little water available during drought conditions by reducing the loss of water from the soil, which also cools the air. • Intact forest and riparian vegetation alongside streams and waterbodies provide shade, keeping waters cooler and reducing evaporation.
Increased precipitation in winter, spring and fall	<ul style="list-style-type: none"> • Forests can be damaged and soils lost by heavy rain storms, resulting in flooding, slope instability and tree failure. 	<ul style="list-style-type: none"> • Healthy, intact forests are better able to stabilize slopes and resist change. • Vegetated areas capture and regulate rainwater, reducing the strain on stormwater infrastructure.
Changing temperatures		
Extreme heat	<ul style="list-style-type: none"> • Heat sensitive ecosystems (e.g. wetlands) and species (e.g. salmon, bats, western red cedar) become stressed at higher temperatures. Impacts are compounded by drought conditions. • Ecosystems and species can be driven to move as conditions become less suitable; however, finding new locations that support their needs may not be possible. For example, cold climate, high-elevation alpine ecosystems are restricted in their ability to move. • Higher outdoor temperatures increase the formation of ground-level ozone, which can damage plants. 	<ul style="list-style-type: none"> • Healthy trees and other vegetation help protect people from extreme heat, by reducing the urban heat island effect. • Trees adjacent to riparian and wetland areas support fish and other wildlife by keeping water cool.
Warmer winters	<ul style="list-style-type: none"> • Increased spread of pathogens, pests and invasive species that are controlled by low winter temperatures. 	<ul style="list-style-type: none"> • Healthy, biodiverse ecosystems are more resilient and better able to resist pathogens, pests and invasive species.

CLIMATIC CHANGES AND HAZARDS	ANTICIPATED IMPACTS TO NATURE AND ECOSYSTEMS	HOW NATURE AND ECOSYSTEMS CAN MINIMIZE IMPACTS
Seasonal shifts	<ul style="list-style-type: none"> • Shifts in seasonal temperatures (e.g. early spring/late fall) can cause disconnects between species and their habitats or food sources. For example, migratory pollinators may return to their home habitat after flowers have already bloomed. 	<ul style="list-style-type: none"> • Resilient, large, and connected ecosystems across the landscape help native species adapt to changing conditions.
Ocean warming and acidification	<ul style="list-style-type: none"> • Impacts to marine and intertidal ecosystems (e.g. die-offs during heatwaves), stress on native species due to changing conditions, and new incidences of invasive aquatic species. 	<ul style="list-style-type: none"> • Impacts can be reduced by lessening human-caused stressors such as over-fishing and pollution, and ensuring healthy biodiverse coastal ecosystems. • Seagrasses may help to reduce salinity and buffer the impacts of ocean acidification.
Wind storms		
High winds exacerbate other hazards	<ul style="list-style-type: none"> • Wind storms, in conjunction with sea level rise, can lead to greater storm surge. 	<ul style="list-style-type: none"> • Natural breakwaters such as reefs can reduce wave action. • Contiguous areas of forest are more resilient to wind damage. Buffer trees can also protect infrastructure and crops from wind.

Note: These climatic hazards can cause cascading impacts – for example, flooding tends to be more severe following a wildfire, landslides tend to occur following heavy rainfall, and severe storms may cause more damage in coastal areas as the sea level rises. Cascading events were experienced in British Columbia during November 2021 when intense precipitation (an “atmospheric river”) resulted in severe flooding and landslides. Non-climatic hazards can also exacerbate climatic ones; for instance, subsidence can increase the risk of coastal flooding and exacerbate sea level rise, and earthquakes can disrupt flood protection infrastructure. Climate change impacts will magnify existing stressors on ecosystems from other human activities. Our understanding of how ecosystems will be affected by cumulative impacts is incomplete, but we do know that large, healthy, connected, and biodiverse ecosystems are more resilient to climate change impacts.

Carbon Storage and Sequestration from Nature and Ecosystems in Metro Vancouver

Carbon stored in nature and ecosystems, including forests, wetlands and intertidal areas, takes thousands of years to accumulate. A conservative estimate of the total carbon stored in the vegetation and soils of the region's nature and ecosystems is 65 million tonnes¹. Every year, these areas sequester additional carbon, removing carbon dioxide from the atmosphere and storing it away long-term. The ecosystems that Metro Vancouver protects in the drinking water supply areas, along with the regional parks system, store 22 million tonnes of carbon. Although carbon storage is not the primary function of these areas, ongoing protection of these significant carbon stores is critical to the region's efforts to reduce greenhouse gas emissions. Figure 2 shows the key natural carbon stores in the region.

Carbon is released from ecosystems when trees are cut down, soils are disturbed, and water cycles are altered (e.g., draining wetlands). Becoming a carbon neutral region by 2050 will require protection of regional ecosystems to ensure the carbon they store remains in place and they are able to continue to remove carbon from the atmosphere, year after year. Restoring, connecting and enhancing these ecosystems in locations that can sustain them can also improve the region's long-term carbon storage potential.

¹ Figures derived from Metro Vancouver's regional carbon storage dataset. The estimate provided applies to the full extents of Metro Vancouver's drinking water supply areas, along with estuarine and intertidal areas.



Carbon Sequestration and Storage

Carbon sequestration is the removal of carbon dioxide from the air on an annual basis. The measure of annual sequestration would be considered as part of the region's efforts to measure carbon neutrality by 2050.

Carbon storage refers to the total amount of carbon stored in the vegetation and soils of ecosystems such as forests, wetlands and intertidal areas, which often takes thousands of years to accumulate.

Carbon sequestration and storage is one of many benefits achieved through ecosystem protection and restoration, but it is not a silver bullet solution – it is a supplemental solution to directly reducing our greenhouse gas emissions through actions explored in other *Climate 2050 Roadmaps*. Significant increases in carbon storage levels in natural systems require ample space for ecosystems to grow and shift, and long timeframes.

FIGURE 1: ESTIMATED GREENHOUSE GAS EMISSIONS REDUCTIONS COMPARED TO CARBON SEQUESTRATION AND STORAGE BY NATURE AND ECOSYSTEMS

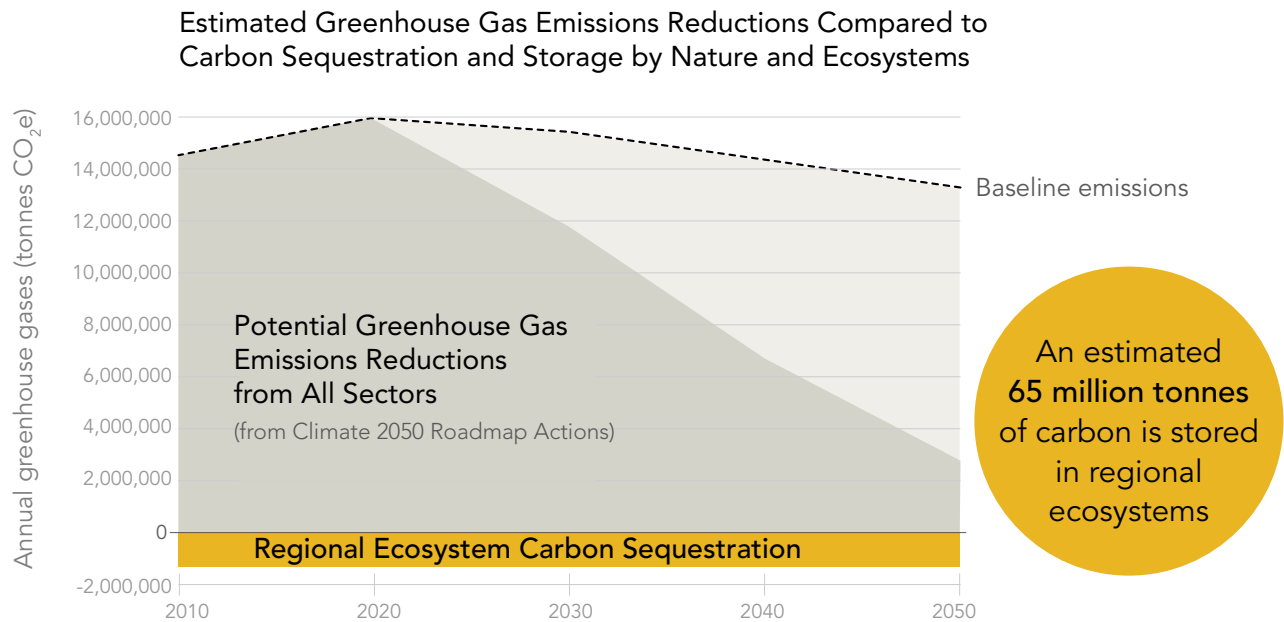
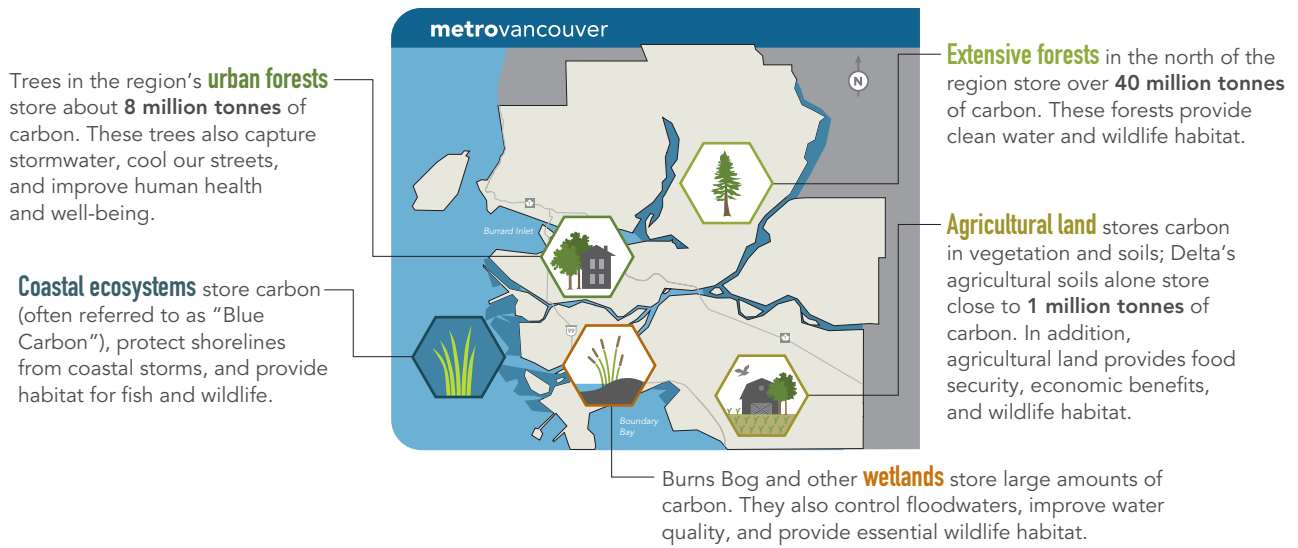


FIGURE 2: KEY NATURAL CARBON STORES IN THE REGION AND THEIR IMPACTS ON REGIONAL CLIMATE RESILIENCE

Millions of tonnes of carbon are stored in vegetation and soil in the Metro Vancouver region





Storing Carbon and Building Resilience Through Nature and Ecosystems

The following section outlines several key concepts that underpin the strategies and actions in this Roadmap. These key concepts are foundational for understanding how nature and ecosystems can become incorporated into the region's climate action strategy.

For nature and ecosystems to be effective as part of climate action planning, biodiversity must be considered and prioritized throughout all actions to ensure ecosystem health, and to avoid unintended consequences (e.g. planting of vegetation that maximizes carbon storage, but negatively affects wildlife and habitat for species). Ecosystems that are biodiverse are able to provide more ecosystem services, or co-benefits. Many ecosystem services are climate change related; for instance, trees and forests

can store carbon but also provide shading, cooling, and other benefits associated with climate change adaptation. Green infrastructure refers to the types of natural, enhanced and engineered assets that provide ecosystem services. Linking different types of green infrastructure together into a functional network is best practice to maximize ecosystem services. Nature-based solutions are a type of green infrastructure that helps address both biodiversity loss and climate change simultaneously. Nature-based solutions are increasingly being integrated into climate action plans to supplement other technological and engineered solutions, such as those identified in other *Climate 2050 Roadmaps*.

Biodiversity

The Metro Vancouver region's rich and diverse natural environment is vital to the people and wildlife who live here. The region's natural areas have tremendous cultural and spiritual importance, contribute to the region's livability, provide a sense of place, and foster biodiversity, which can be broadly defined as the variety of life. The region is home to the Fraser River Estuary, an important and productive marine ecosystem that forms the mouth of one of the largest salmon-bearing rivers in the world, and supports one of the highest concentrations of migratory birds in Canada. The Fraser River Estuary is one of four Important Bird Areas (IBA) being assessed as Key Biodiversity Areas – internationally recognized sites defined by a global standard – within Metro Vancouver. Large, contiguous ecosystems such as these have benefits for biodiversity, but the smaller, “stepping stone” habitats are important as well. For example, while the north shore mountains contain some of the highest quality habitat in the region, habitats at lower elevations are used by birds migrating back to the region in early spring while habitats in the north shore forests are still frozen. Collectively, the region's ecosystems - from the forests, wetlands, and watercourses to the urban trees and parks - form a mosaic of habitats that support biodiversity.

“ Biodiversity enables Nature to be productive, resilient and adaptable. Just as diversity within a portfolio of financial assets reduces risk and uncertainty, so diversity within a portfolio of natural assets increases Nature's resilience to shocks, reducing the risks to Nature's services.”

*THE ECONOMICS OF BIODIVERSITY:
THE DASGUPTA REVIEW*

Climate change and biodiversity loss are two interlinked challenges occurring simultaneously, both globally and locally. Metro Vancouver's ecosystems are affected by a changing climate (see Table 1), and the lower mainland of southwestern British Columbia where they are situated has been identified as an ecoregion at significant risk to biodiversity loss. As climate change places stress on ecosystems, they become less resilient and less capable of storing carbon. In order for nature and ecosystems to provide benefits and ecosystem services, they must be resilient to the impacts of human activities, including climate change. Resilient ecosystems are both healthy and biodiverse. For example, a healthy forest that supports a wide variety of tree species will store more carbon and recover faster from disturbances, such as fire or pests, because not all species will be impacted to the same degree and some will rebound more easily. Protecting and enhancing biodiversity in nature and ecosystems maximizes their ability to provide climate change benefits.



Species Case Study: Pacific Salmon

In the Pacific Northwest, salmon are a keystone species, supporting people, ecosystems and wildlife. Salmon have cultural, spiritual and food source significance in our region, particularly to First Nations communities. First Nations' connection to water and salmon remains strong despite the impacts of colonization. The Fraser River is one of North America's greatest salmon-producing rivers. The river and its main tributaries within Metro Vancouver – Kanaka Creek, Pitt River (Alouette River, Widgeon Creek), Coquitlam River and Brunette River – weave through the region, providing important habitats for salmon and other species.

Eagles, bears, and orcas all rely on salmon as a food source. As migrating salmon return to rivers and are eaten by other species, essential nutrients from their carcasses are transferred to forests and other ecosystems.

Salmon, and the habitats they thrive in, are at risk from climate change impacts. In the Metro Vancouver region, we are projected to experience warmer and wetter winters, hotter and drier summers, reduced snowpack, and more precipitation falling as rain and less as snow. These impacts may decrease the amount of water available in streams during dry periods, raising stream temperatures. Salmon are sensitive to warming temperatures – they may not enter streams until the water has cooled to a specific temperature, and warmer temperatures can affect both survival and reproductive success. The Fraser River summer water temperature has warmed by, on average, 1.5°C since the 1950s, and this trend is projected to continue. We can take action to help salmon adapt to climate change impacts. Restoring riparian corridors with native vegetation can cool stream temperatures. Integrating fish passage into the design of flood control infrastructure will ensure salmon can continue to reach their spawning grounds.

We can also identify and protect critical salmon spawning habitat – often this habitat provides other ecosystem services. For example, eelgrass serves as nursery habitat for salmon, but also reduces wave impacts from coastal storms, and stores carbon.

Ecosystem Services

The importance of nature and ecosystems in the Metro Vancouver region is intrinsic, invaluable and unmeasurable, and these environments have significant cultural and spiritual importance for all communities. The concept of 'ecosystem services' (see Figure 3) has emerged as a tool to allow us to more fully understand the breadth of benefits that nature provides, including cultural ones. Many of these benefits also relate to climate change – for instance, nature and ecosystems store carbon, cool city streets, clean stormwater, and moderate floods. The concept of ecosystem services can help underscore the fact that we live in reciprocity with nature; while ecosystems provide benefits to humans, we also co-exist in concert with the natural world.

Ecosystem services are not typically accounted for in decision-making, and this lack of understanding results in a devaluation of nature, contributing to its ongoing loss and degradation. As technology and methods that allow for measurement of ecosystem services improve, it will become easier to incorporate ecosystem services into broader decision-making, resulting in better outcomes for both people and nature.

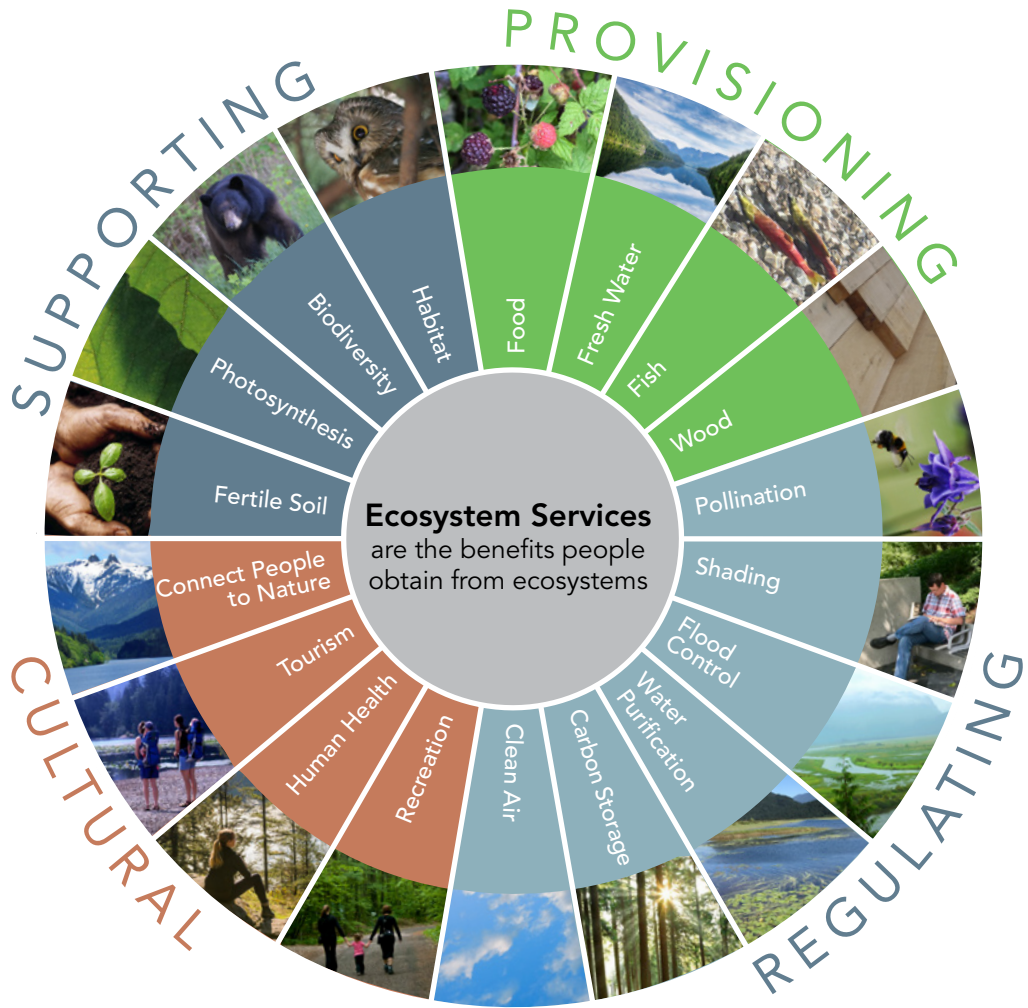
Human Health Benefits of Nature and Ecosystems

Health benefits from nature are wide-ranging and include:

- Improved mental health, including reduced depression and stress
- Improved physical health, including reduced obesity, diabetes, and cardiovascular disease, and increased immune system function
- Improved pregnancy outcomes
- Improved cognitive function, with slower cognitive decline in the elderly and improved cognitive development in children
- Improved social cohesion
- Reduced mortality risk
- Reduced medical costs

Social factors including income level, gender, and ethnicity can have a significant influence on how healthy a person is, with vulnerable populations experiencing greater health inequality. Evidence suggests that the health benefits linked with access to green space may be strongest for vulnerable populations.

FIGURE 3: ECOSYSTEM SERVICES PROVIDED BY HEALTHY ECOSYSTEMS



Green Infrastructure

The term Green Infrastructure refers to the natural, enhanced and engineered systems (shown in Figure 4) that collectively store carbon, help communities adapt to climate change, and provide society with a range of other ecosystem services. This Roadmap considers green infrastructure across all landscapes and land use types, from urban street trees and green roofs to natural ecosystems such as wetlands, forests, and watercourses.

FIGURE 4: TYPES OF GREEN INFRASTRUCTURE



Stormwater management is a key driver for the implementation of enhanced and engineered green infrastructure solutions, and demand for this ecosystem service is likely to increase due to climate change. However, a major benefit of green infrastructure is that it provides a wide range of ecosystem services beyond stormwater management, including support for biodiversity and human health and well-being. In order to maximize benefits, green infrastructure needs to be planned and implemented with multiple ecosystem services in mind.

Metro Vancouver member jurisdictions have considerable experience planning and implementing green infrastructure projects; however, there is a need to move beyond individual projects and pilots to broad implementation across the region, with consideration given to ‘networking’ the individual elements of green infrastructure into a functioning system.

Green Infrastructure – a Cross-Cutting Climate Action

Green infrastructure will need to be integrated across different land uses and involve a range of sectors. This Roadmap focuses on the importance of creating a network of green infrastructure and planning for co-benefits, including support for biodiversity. Connections between other *Climate 2050* issue areas and green infrastructure are outlined below:

Land Use and Urban Form – the land use planning framework supports green infrastructure planning and implementation through the protection of lands important for conservation, recreation, and agriculture, as well as the integration of green infrastructure into the design of new or redeveloped urban areas, reducing the loss of trees and greenspace, and creating better places for people and nature.

Agriculture – agricultural land includes remnant natural vegetation such as wetlands and riparian areas, and other permanent vegetation (e.g. hedgerows). These areas provide opportunities for wildlife, pollinator and bird habitat and connectivity across the landscape. Supporting long-term farm health and resiliency through the expansion of regenerative agriculture practices (e.g. cover cropping) also enhances biodiversity and ecosystems services.

Transportation – opportunities exist to reduce climate change impacts on the transportation network by integrating green infrastructure into transportation networks (e.g. through planting trees and other vegetation along road and railway verges and recreational greenways). Siting of infrastructure to avoid fragmentation of green infrastructure networks also supports a regional green infrastructure network.

Water and Wastewater Infrastructure – green infrastructure in urban areas tends to be heavily focused on stormwater management benefits. Green infrastructure can supplement grey infrastructure by filtering stormwater and reducing the amount of stormwater overflow during smaller rain events. Considering other benefits from green infrastructure (such as support for biodiversity and human health) increases the range of potential benefits achieved in urban areas.

Buildings – buildings dominate the urban landscape, so there is significant potential to leverage the climate-related benefits of green infrastructure (e.g. providing shade and capturing rainwater) by incorporating green infrastructure elements onto and around built structures.

Energy – green infrastructure (such as trees) can reduce the amount of energy needed to cool buildings and people by providing shade and reducing air temperatures.

Human Health – green infrastructure provides a range of health benefits to people through connection to nature, as well as by providing services that support adaptation, including providing shade and capturing flood waters. For more information on the connections between nature and human health, see page 27.

Nature-Based Solutions

Green infrastructure, if designed and implemented with biodiversity outcomes as a priority (e.g. a green roof that creates habitat for pollinators), is an example of a nature-based solution to climate change.

Locally and internationally, there has been a growing understanding and recognition of the climate change and biodiversity co-benefits that ecosystems provide, and this has led to the emergence of nature-based solutions as a focus for climate action. Nature-based solutions are holistic actions that protect, sustainably manage, and restore ecosystems, while simultaneously addressing societal challenges such as climate change. These solutions provide benefits for humans and wildlife alike, and ideally, these solutions recognize that humans and nature are interconnected and mutually dependent. For example, seagrass meadows store carbon, reduce impacts of coastal storms on shorelines, and provide essential habitat for fish and other species.

While climate change actions have historically been focused on technological and engineered solutions – which continue to be important – nature-based solutions can supplement these actions and become an integral part of climate action planning. The intentional inclusion of nature-based solutions in climate action plans is a relatively new approach and awareness, protocols and standards for these types of interventions continue to evolve. International guidance documents such as the *IUCN Global Standard for Nature-based Solutions* provide a framework for the verification, design, and scaling up of nature-based solutions. First Nations have stewarded the lands, waters, and air for millenia as part of a reciprocal relationship with nature. These long practiced approaches can inform current efforts to integrate nature-based solutions into climate action planning.

FIGURE 5: NATURE-BASED SOLUTIONS FOR ADDRESSING CLIMATE CHANGE

Nature-based Solutions for Addressing Climate Change



Barriers and Opportunities

The Metro Vancouver region is growing by approximately 35,000 people per year, and the impacts from human activities, including urban development, logging, and climate change have resulted in ecosystem change and loss. Nature and ecosystems offer important benefits, but if they are lost, it will require substantial time and available space for them to regenerate into mature, functioning systems. Additional barriers, and opportunities to overcome them, are included in Table 2 below:

TABLE 2: BARRIERS AND OPPORTUNITIES ASSOCIATED WITH STORING CARBON AND BUILDING RESILIENCE WITH NATURE AND ECOSYSTEMS

BARRIER	OPPORTUNITY
The region is facing a dual challenge of climate change and biodiversity loss, the impacts of which are interrelated.	Taking action on both biodiversity loss and climate change together is the key to success. There is an opportunity to implement nature-based solutions that help to address both challenges. Healthy, resilient, and biodiverse ecosystems are needed to support biodiversity and climate action.
Species and ecosystems are experiencing increasingly challenging environments that will continue to change in the future.	It is important to consider future climate conditions in planning processes; for instance, considering how future climate conditions might impact the urban forest, invasive species, natural resource management, and restoration work.
This region has a constrained land base, high costs and competition for land, and a steadily increasing population – all of which present challenges when trying to conserve space for nature and ecosystems. To achieve substantial gains in carbon storage, for instance, would require significant space for tree planting and ecosystem restoration.	Space for nature must be considered and integrated throughout different land uses. This prioritization requires innovation and collaboration; for instance, collaboration between multiple departments to maximize both housing density and tree canopy in urban areas. Multi-functional ecosystems across land uses support more habitats, which improves overall biodiversity.
Informed decision-making requires regionally-specific data (e.g. vulnerability of ecosystems to climate change, susceptibility to new invasive species), and this data is not always available or current.	Some regional datasets have been developed to inform decision-making. These datasets were generated, and will be updated, using a consistent methodology across the region, and trend reporting can occur at regular intervals. As technology improves and costs decrease, some data will become increasingly more accessible. Partnerships with agencies and organizations that produce relevant data can also help overcome this barrier.
Lack of understanding of Indigenous Knowledge systems can make it difficult to integrate it into existing processes and with Western science.	First Nations have been stewards of the region’s lands, waters, and air since time immemorial. There is an opportunity to learn together and share knowledge to address climate change, contributing to improved understanding between Indigenous and non-Indigenous Peoples.

BARRIER	OPPORTUNITY
<p>Approaches such as nature-based solutions may not be widely understood due to a lack of knowledge and training. This uncertainty leads to perceived risks around the performance, cost and maintenance of using new and innovative solutions. In addition, the results from case studies and pilot studies in other locations are not always transferable to this region.</p>	<p>There is an opportunity to develop knowledge in a range of sectors through professional training. Providing a regional forum to share technical knowledge, as well as the development of standards and guidelines, can help to dispel some of the uncertainties and instill confidence in new practices. Embedding new approaches as shared objectives across organizations avoids the risk of siloed initiatives within one department or discipline.</p>
<p>The inherent value of nature and the benefits it provides society are not fully recognized, leading to a lack of priority given to protection and restoration efforts.</p>	<p>Integrating natural assets and the ecosystem services they provide into decision-making will improve overall understanding and support efforts to prioritize protection and restoration.</p>
<p>The coastal and marine environment in the Metro Vancouver region is uniquely impacted by climate change. Ecosystems in these environments are affected by coastal squeeze, warmer temperatures, changing hydrology, and ocean acidification. These environments are governed by multiple agencies with differing levels of legislative authority, making it difficult to collaborate on solutions to these challenges.</p>	<p>There is an opportunity to monitor and share information related to the coastal marine environment among regional partners, and to connect with governments, agencies and organizations that have more direct influence in coastal and marine environments, including member jurisdictions, First Nations, and the federal and BC governments.</p>

Equity Considerations

The impacts of climate change will affect everyone, but they pose a greater threat to people who are already vulnerable due to overlapping factors such as income and health. For example, vulnerable populations with lower incomes have fewer resources and less adaptive capacity to respond to climate change impacts; these challenges can be magnified by poor health. Typically, those who are the most at-risk to climate change impacts have contributed the least to greenhouse gas emissions. Given the interlinkage between vulnerable populations and climate change impacts, incorporating equity considerations into climate change policy is imperative.

As climate action is planned and implemented, it will be important to consider how different groups are affected by climate impacts, and who may be at a greater risk. Including these considerations throughout the process may mean targeting or timing action to assist those who are most vulnerable. A relevant example would be identifying vulnerable communities living in areas with low levels of tree canopy, parks and other green space.

Green infrastructure enhancements can have unintended social consequences; for instance, researchers are investigating whether ‘green gentrification’ is contributing to the displacement of marginalized communities. If green infrastructure is to provide benefits to those most in need, it is essential to consider the potential for these kinds of unintended consequences and involve the community early in an inclusive planning process.



The Journey - Storing Carbon and Building Resilience through Nature and Ecosystems

Climate 2050 Roadmap Connections

There are many links between nature and ecosystems and other issue areas. Metro Vancouver is exploring which linkages must be considered when developing climate policies and actions.

Land Use and Urban Form – policies that support more compact, complete communities, and protect ecologically important areas from development lead to increased resilience and carbon storage.

Water and Wastewater Infrastructure – green infrastructure such as green roofs and rain gardens improve building energy efficiency, and absorb rainfall and stormwater, which reduces the loading on built infrastructure during smaller rain events and restores urban biodiversity. Separation of combined sewers into separate sanitary and storm systems allows for partial restoration of original drainage courses (e.g. daylighting streams).

Energy – nature and ecosystems cool urban areas, reducing the need for air conditioning and decreasing overall energy use.

Human Health and Well-Being – nature-based climate change solutions (such as planting trees in urban areas) improve mental and physical health.

Agriculture – agricultural lands can be managed to protect natural areas, and enhance ecosystem services that build resilience to climate impacts and store carbon.

Buildings – nature and ecosystems can help reduce greenhouse gas emissions from buildings and increase resilience by protecting from flooding and heat.

Waste – biosolids and compost are soil amendments that improve soil health, improve water retention, promote vegetation growth, and restore disturbed ecosystems.

Climate Goals and Targets for Nature and Ecosystems

Metro Vancouver's *Climate 2050 Strategic Framework* has set the following regional vision to guide the region's response to climate change:

- Metro Vancouver is a carbon neutral region by 2050
- Infrastructure, ecosystems, and communities are resilient to the impacts of climate change

Metro Vancouver has also set an interim target of 45% reduction in greenhouse gas emissions from 2010 levels, by 2030.

Achieving this vision means setting goals in each of the *Climate 2050 Roadmaps*, in order to ensure that each sector in the region plays as strong a role as possible in getting to a carbon neutral, resilient region.

Metro Vancouver has set the following goals for nature and ecosystems in this region:



Goal

Nature and ecosystems are resilient, protected, maintained, enhanced, restored and connected, to maximize ecosystem services across the region.

TARGETS

By 2050:

- Protect 50% of the region for nature
- Achieve 40% tree canopy cover within the Urban Containment Boundary

What is a Carbon Neutral Region?

A carbon neutral region means that we have achieved the deepest greenhouse gas emission reductions possible across all economic sectors, and any emissions left are balanced out by the carbon dioxide removed from the atmosphere by the plants, trees, and soil in the region, as well as by potential carbon capture technologies that are under development.



Goal

Nature-based solutions that support biodiversity are included in the region's response to climate change.

MEASURABLE OUTCOMES:

Measurable outcomes for nature-based solutions are still to be determined based on additional review and discussion.

Many of the actions identified in this Roadmap will need to be participated in or led by other governments (e.g., national, provincial, local, and First Nations) as well as other regional partners. Metro Vancouver has a long history of working with other governments towards common goals. Fortunately, many of the organizations needed to make this transition are already actively working toward similar goals, including: the Provincial Government and its *CleanBC Plan*, *CleanBC Roadmap to 2030*, and *Climate Preparedness and Adaptation Strategy*; the Federal Government's recently strengthened climate plan called *A Healthy Environment and a Healthy Economy*; First Nations climate-related goals and initiatives; Metro Vancouver's member jurisdiction's own community and corporate climate plans; utilities; and, increasingly, industry associations.

Best Practices to Guide Success

The next section outlines 5 strategies and 31 actions; these measures set a pathway forward for nature and ecosystems to support the vision of a carbon neutral and resilient region by 2050. The following principles should be considered as best practices when implementing the actions throughout this Roadmap:

1. Prioritize biodiversity, equity, and conservation objectives when implementing nature-based climate solutions.
2. Integrate different forms of knowledge, including Western science and Indigenous Knowledge.
3. Prioritize planting native species in natural areas. Prioritize planting native species in urban areas where possible, but use non-native species to augment in challenging sites where native species will not thrive.
4. Choose solutions that support multiple ecosystem services, rather than focusing on only one ecosystem service.
5. Prioritize protection of mature trees and ecosystems.
6. Integrate environmental objectives so they are shared priorities across whole organizations and everyone is working to achieve them.
7. Offsetting the loss of ecosystems (e.g. through habitat compensation) should be done on a net-gain basis, but only considered after options for avoiding and reducing impacts have been explored.
8. Ensure long term maintenance and ecosystem health is considered and prioritized after planting.

Connecting the Nature and Ecosystems Roadmap and Metro 2050

Metro Vancouver works with member jurisdictions to develop, implement and steward *Metro 2050*, the regional growth strategy. The strategy represents the regional federation's ongoing commitment to building a compact metropolitan region - where approximately two-thirds of the land is designated for agricultural, recreational, and conservation uses. *Metro 2050* defines actions and directions for Metro Vancouver, member jurisdictions, and TransLink.

Though *Metro 2050* and *Climate 2050* are distinct plans, they are intended to be mutually-supportive, with policies and actions that are complementary and focused on common objectives. The *Climate 2050 Nature and Ecosystems Roadmap* builds on *Metro 2050* with further actions to protect stores of carbon and build resiliency with nature and ecosystems.

BIG
Move

Big Moves are foundational to achieving the 2030 and 2050 targets, and should lead to the most significant greenhouse gas reductions and/or climate resilience.

Corporate
LEADERSHIP

Corporate Leadership actions are ones Metro Vancouver will implement in its corporate operations to demonstrate leadership and support regional actions.

METRO
2050

Metro 2050 identifies actions that are already adopted through *Metro 2050*, the regional growth strategy.



Strategy 1: Protect, Restore, and Enhance the Region's Ecosystems

To become a carbon neutral and resilient region by 2050, we need to make substantial commitments to protect, restore, and enhance nature and ecosystems, and at a larger scale than ever before. Currently, about 40% of the region's land base is protected by government and other organizations in the form of parks and other publically-owned lands, for the purposes of conservation or recreation. Large, healthy, connected, and biodiverse ecosystems are more resilient to climate change impacts and therefore better able to store carbon and support climate change adaptation. Scientific reviews of how much of the Earth should be protected vary, but 50% - also known as 'Nature Needs Half' - is considered a mid-point of estimates and is supported by a range of scientific studies (see callout box - Why Protect 50% of the Region?).

Increasing the amount of parkland in the region also provides additional space for the region's growing population to access nature and recreate, contributing to community and individual health and well-being. Given that this region faces significant land use constraints, meeting this target will involve making trade-offs between competing priorities, reducing the amount of land available for urban development and other uses.

Indigenous Peoples have lived on these lands since time immemorial, and continue to steward the lands, waters, and air as part of a reciprocal relationship with nature. Historically, protected areas have often been places where restrictions were in place for First Nations, preventing access to natural areas to practice cultural activities. Moving forward, the participation and leadership of First Nations in protected area management should be prioritized through collaborative agreements and approaches to shared stewardship.

Why Protect 50% of the Region?

There have been growing efforts globally to set ambitious area-based targets for protection. For example, the High Ambition Coalition for Nature and People, an intergovernmental group of 70 countries including Canada, committed to protecting 30% of land and seas by 2030 (known as 30 x 30). This is intended as an interim goal, with another 20% needed as 'climate stabilization areas' to keep climate change below 1.5 degrees.

Studies estimating the percentage of the Earth that should be protected provide values from 30% to 70%, or even higher. **The call for 50% - known as Nature Needs Half - is a mid-point of these values and is supported by a range of scientific studies.**

Ecosystem Loss in the Metro Vancouver Region

Metro Vancouver maintains the [Sensitive Ecosystem Inventory](#) (SEI) of the region's most important ecological areas and monitors it for change. Between 2009 and 2014, 1,600 hectares of ecosystem loss was documented, including 1,000 hectares of forest, 120 hectares of wetland, and 100 hectares of riparian areas. Primary drivers of ecosystem loss were urban development (as planned within local official community plans) and logging (as permitted by the BC government).

The losses documented by the SEI represent just four years of change. Estimates of ecosystem loss since European settlement began in the early 1800's help to place recent losses within a longer timeframe of cumulative impacts. For example, as much as 85% of the region's freshwater wetlands were lost by 1990².

2 Boyle, C.A., L. Lavkulich, H. Schreier, E. Kiss. 1997 Changes in land cover and subsequent effects on Lower Fraser Basin ecosystems from 1827 to 1990. *Environmental Management*. 21: 185-196.

Prioritizing the protection of the region’s remaining mature ecosystems will focus effort on the highest functioning, most biodiverse areas. Once mature ecosystems are degraded or lost, it will take many years (and potentially extensive effort and resources) to return them to a similar well-functioning state.

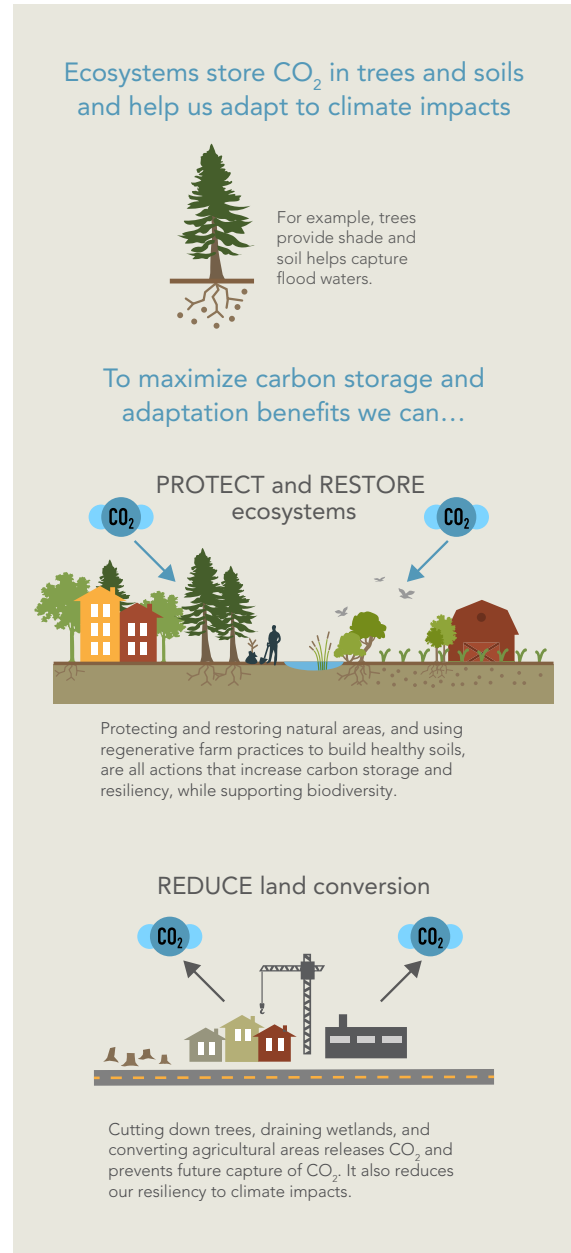
Restoration provides us an opportunity to gain back ecosystems and the services they provide. Examples of how restoration efforts could support climate action include:

- increasing ecosystem connectivity between major protected areas to allow species to move in response to climate change;
- improving the health of ecosystems to keep large carbon stores locked away;
- replacing hard shoreline infrastructure with gently sloped vegetated shorelines to reduce the impacts of sea level rise and wave action; and
- restoring or enhancing wetlands to protect against flooding and daylighting streams to improve hydrological function.

Restoration planning will need to take into account the impacts of climate change in selecting plant species and choosing native species that can cope with the new and changing conditions.

By protecting and restoring a range of ecosystem types in different situations across the landscape (e.g. both high and low elevation forests), we provide for a diversity of ecosystems, species, and conditions. Diverse ecosystems are more resilient and have a greater capacity to recover from disturbances.

FIGURE 6: THE CLIMATE CHANGE BENEFITS OF PROTECTING AND RESTORING ECOSYSTEMS



STRATEGY 1	Potential Impacts of Strategy	Key Partners
	<ul style="list-style-type: none"> • Sets a collective regional vision for ecosystem protection • Expands the amount of land protected for nature • Increases collaboration and knowledge-sharing on ecosystem protection, restoration, and enhancement in the region 	<ul style="list-style-type: none"> • Member jurisdictions • First Nations • BC government • Federal government • NGOs

1.1 Protect an Additional 10% of the Region for Nature.



All member jurisdictions, through implementation of the regional growth strategy, will identify local ecosystem protection targets and demonstrate how these targets will contribute to the regional target of protecting 50% of the region for nature. In addition to directly contributing to protection efforts (action 1.2), Metro Vancouver will support this process by providing data, information resources, and a forum for discussion.

1.2 Protect, Restore, and Enhance Natural Areas at the Regional Scale.



Continue to implement the *Regional Parks Land Acquisition 2050* strategy to increase the amount of important natural areas protected in the Regional Parks system. In regional parks and the drinking water supply areas, continue to restore and enhance degraded sites, enhance biodiversity, and promote ecosystem resilience. Advocate to the federal and BC governments and other partners to protect, or fund the protection of, additional natural areas in the region, taking into consideration the importance of connecting existing protected areas.

1.3 Protect, Restore, and Enhance Nature at the Local Scale.



All member jurisdictions, through implementation of the regional growth strategy, support the protection, enhancement and restoration of ecosystems through measures such as land acquisition, density bonusing, development permit requirements, subdivision design, conservation covenants, land trusts, and tax exemptions.

1.4 Incorporate Climate Change Planning into Protected Area Management.



Develop a Regional Parks Climate Action Strategy. Continue work to improve understanding of climate impacts on the ecosystems and infrastructure in regional parks and the drinking water supply areas. Work with knowledge holders including First Nations, and other agencies with a role in protected area management, to improve understanding of climate impacts on the region's protected areas and develop best practice approaches to managing these areas in the context of a changing climate.

1.5 Prioritize the Conservation of Ecosystem Health and Biodiversity in BC Forest Management.

Advocate to the BC Government to make ecosystem health and biodiversity conservation the overarching priority of forest management and implement the recommendations of the strategic review of old forest management³.

1.6 Support Ecosystem Protection, Restoration, and Enhancement.

Provide data, guidance materials and best practices to inform the protection, restoration, and enhancement of ecosystems in the region. Convene a forum to provide opportunities for cross-regional collaboration.

3 A New Future For Old Forests: A Strategic Review of How British Columbia Manages for Old Forests Within its Ancient Ecosystems

1.7 Reverse the Loss of the Region's Ecosystems.

Advocate to the federal government, the BC government, member jurisdictions and other agencies to commit to ecosystem restoration and enhancement at a significant scale. Collaborate with others and identify opportunities to make significant gains through restoration and look for partnerships and funding opportunities to magnify efforts.

1.8 Manage Invasive Species.

Support regional invasive species management by developing and promoting best practices, tracking disposal options, and working with researchers to improve our understanding of the potential spread of invasive species as our climate continues to change. Employ best practices to prevent the introduction and spread of invasive species on lands managed by Metro Vancouver. Continue to support opportunities for cross-regional collaboration.

**Corporate
LEADERSHIP**

Old Growth Forests

Old growth forests of coastal BC are those with dominant trees older than 250 years, although they will have a diversity of aged trees present as the oldest trees die, creating space for younger trees to grow. The diversity of tree sizes and ages creates a wide variety of habitats, which supports many different species. As well as having high biodiversity values, old growth forests store large amounts of carbon, approximately 1,000 tonnes of carbon per hectare. Mature and young forests are also critical for carbon sequestration (ongoing uptake of carbon as trees continue to grow) and they provide ecosystem connectivity so wildlife species can move across the landscape. Protecting mature and young forests, in addition to old growth, will increase the total amount of old growth in this region over the long term.

Old Growth Forests in Metro Vancouver

Metro Vancouver secures land for regional parks to protect the region's natural areas and to connect people with nature. Metro Vancouver is also responsible for developing long range plans for managing our region's drinking water sources, including 60,000 hectares of restricted access, protected water supply areas. These areas include the most intact old-growth forest ecosystems in south-western BC. Metro Vancouver tracks old growth and other rare, fragile, or at-risk ecosystems using the [Sensitive Ecosystem Inventory](#). Within the region, including the full extent of Metro Vancouver's drinking water supply areas that extend north of the MVRD boundary, there are 49,853 ha of old growth forest. Of this amount, 34,805 (70%) is on Metro Vancouver owned or managed lands: 33,011 ha (66%) within watersheds and 1,794 ha (4%) in Regional Parks.

Metro Vancouver Corporate Leadership in Ecosystem Protection and Restoration

The regional parks system currently includes over 13,800 hectares of land which protects natural areas and provide opportunities for people to connect with nature. Metro Vancouver is also responsible for protecting the region's drinking water supply areas from development, pollution, and human-caused disturbances. By protecting these watersheds for drinking water we are also protecting about 60,000 hectares of mostly forested land.

Ecological Health Framework – Adopted by the Board in 2018, this framework encapsulates Metro Vancouver's collective efforts around ecological health and provides guiding principles, goals, and strategies to help achieve the vision of a beautiful, healthy, and resilient environment for current and future generations. Specifically, the *Ecological Health Framework*:

- Identifies Metro Vancouver's role in protecting and enhancing ecological health as it relates to its services and functions;
- Provides a foundation for integrating ecological health into Metro Vancouver's corporate decision making;
- Identifies how Metro Vancouver will report on ecological health-related initiatives across the organization; and
- Supports regional efforts to protect and enhance ecological health.

Regional Parks Land Acquisition 2050 Strategy – *Regional Parks Land Acquisition 2050* took a systematic, evidence-based approach to identifying land suitable for protection as a regional park. The result identifies the most regionally important unprotected natural areas that could be acquired for future new and expanded parks. It envisions growing the regional parks system into a connected network of resilient regional parks and greenways that protect regionally important natural areas and connects people to them.

Invasive Species Resources – Metro Vancouver provides a suite of resources to support invasive species management, including an online course, locally-tested best management guidance for practitioners, and fact sheets for residents.

Ecosystem Restoration in Regional Parks - Guided by the *Natural Resource Management Framework*, Regional Parks has an ongoing program to restore degraded sites, enhance biodiversity, and promote ecosystem resilience in the Regional Parks System. Every year through this program, thousands of trees and other native vegetation are planted, thousands of kilograms of invasive plants are removed, ecosystem health is monitored, and habitat improvements are made to support native biodiversity.

Ecohydrological Restoration of Burns Bog - Metro Vancouver works with other stakeholders to restore the bog and prevent the drying out of peat - a process that releases greenhouse gases.

Strategy 2: Connect Green Infrastructure

Green infrastructure includes both natural and urban elements (see Figures 4 and 7). From street trees, hedgerows and green roofs to forests, wetlands, and rivers, they provide a range of climate change, biodiversity, and health benefits. These benefits are magnified when individual green infrastructure elements are connected together into a network across jurisdictional boundaries, increasing resilience to climate impacts and supporting the movement of species across the landscape. A regional green infrastructure network would maximize ecosystem services by linking together natural and urban ecosystems through a robust system of recreational greenways, aquatic blueways, and wildlife crossings and corridors.

Developing a regional green infrastructure network would necessitate creating a collaborative and cross-jurisdictional process, building on existing local networks, and identifying opportunities to maximize associated climate change adaptation, ecosystem connectivity, and human health benefits.

2.1 Develop a Regional Green Infrastructure Network.



Through implementation of the regional growth strategy, collaborate with member jurisdictions, First Nations, and other agencies to identify a Regional Green Infrastructure Network that connects ecosystems and builds on existing local ecological networks, while maximizing resilience, biodiversity, and human health benefits. Collaboratively prepare Implementation Guidelines to support a Regional Green Infrastructure Network.

2.2 Green Urban Areas.

Support the greening of urban areas by developing and sharing best practices and guidelines to incorporate green infrastructure into new developments and redeveloped areas. Work collaboratively with member jurisdictions and other partners to identify barriers and opportunities to integrating green infrastructure in urban areas.

STRATEGY 2	Potential Impacts of Strategy	Key Partners
	<ul style="list-style-type: none"> • Creates a process to work together to connect a cross-regional network • Integrates ecosystem connectivity into green infrastructure planning and implementation 	<ul style="list-style-type: none"> • Member jurisdictions • First Nations • BC government • Federal government • NGOs • Academic institutions • Agricultural land owners

2.3 Green the Regional Greenways Network.



Identify opportunities to incorporate green infrastructure, restoration of ecosystems and unprotected natural areas in greenway planning and design to enhance ecosystem connectivity and provide shading and other benefits to trail users. Advocate to other agencies who own or manage parts of the Regional Greenways Network to do the same.

2.4 Minimize Ecosystem Fragmentation.



Avoid ecosystem loss and fragmentation when developing and operating infrastructure within the regional growth strategy Conservation and Recreation regional land use designation, but where unavoidable, mitigate the impacts, and advocate to other agencies to do the same. All member jurisdictions, through the implementation of the regional growth strategy, will discourage or minimize the fragmentation of ecosystems through low impact development practices that enable ecosystem connectivity.

2.5 Develop Data and Resources to Support Ecosystem Connectivity.

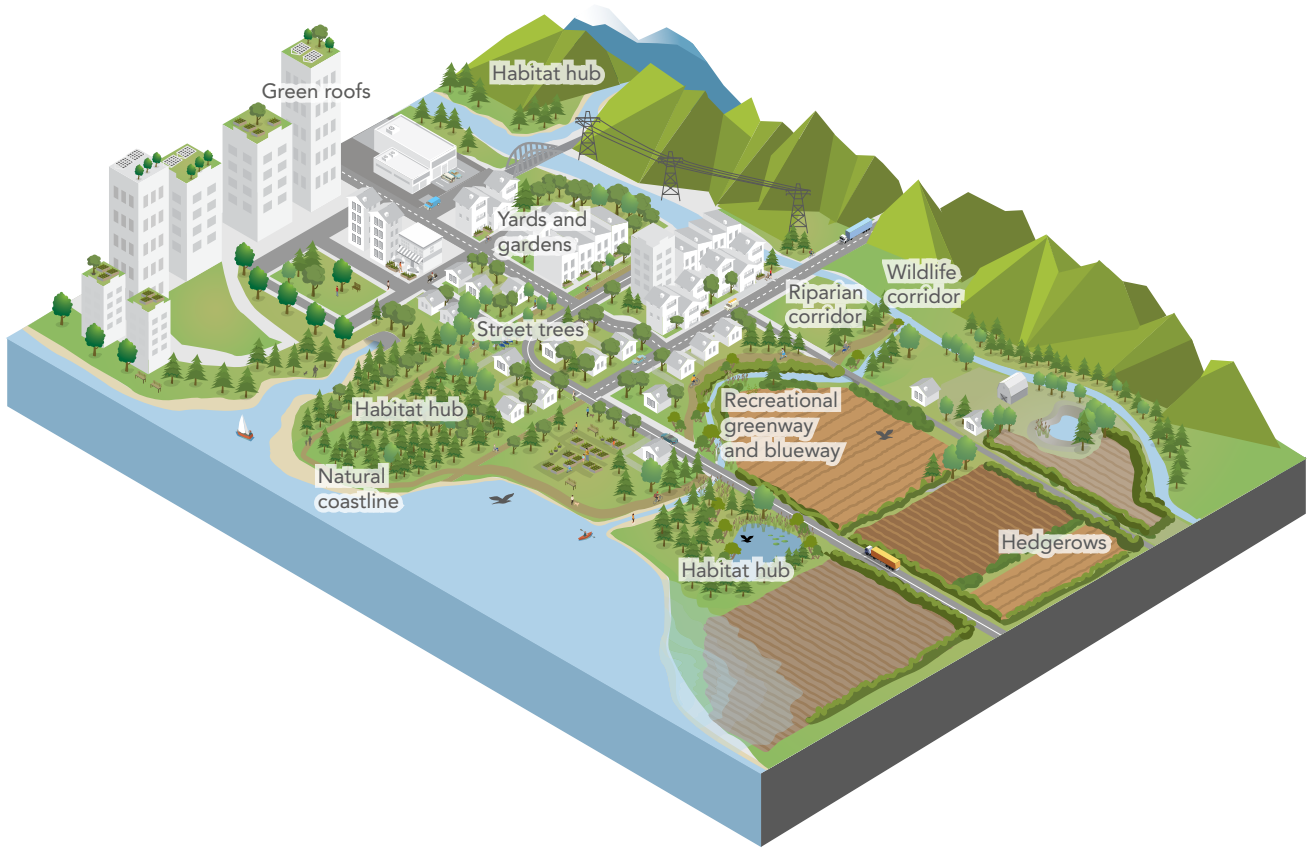
Continue to work with others to develop and share data and resources related to ecosystem connectivity, including resources that identify the impacts of climate change on connectivity.

Nature in the City

Nature and ecosystems within urban areas can maximize ecosystem services – such as cooling and shading – close to where people live, work and play. By bringing nature into the city through enhancement and restoration – also known as ‘rewilding’ - urban ecosystems can play a role in supporting biodiversity across multiple scales, from green roofs on individual buildings to large, open, and natural spaces at the urban periphery. A Regional Green Infrastructure Network (as described in action 2.1) would connect ecosystems both between and within the region’s urban areas.

FIGURE 7: COMPONENTS OF A GREEN INFRASTRUCTURE NETWORK

Green Infrastructure Network



Components of a Regional Green Infrastructure Network



Habitat hubs are larger, intact core habitat areas and are a critical feature of any green infrastructure network. They provide areas of refuge for a diverse range of species, including those less tolerant of human disturbance. Smaller sites also provide habitat and can act as 'stepping stones' between hubs.



Recreational greenways and blueways provide opportunities for people to recreate on land and water, but these areas are also used by wildlife to move through the region. Wildlife can be supported by enhancing natural vegetation alongside green and blueways, as well as increasing the width of vegetated buffers.



Corridors are linear areas of habitat that support movement of birds, fish and mammals between hubs and other areas of habitat. They can span short or long distances. As land is developed, these remaining pathways become even more critical. Also known as wildlife, habitat, or green corridors, these areas also include riparian corridors that follow the path of a stream or river.



Natural coastlines provide important habitat for several species, while supporting connections between marine and terrestrial habitats and along the foreshore.



Urban green infrastructure includes a wide variety of features that support nature in the city and provide habitat for wildlife that is tolerant of human disturbance. Features include yards and gardens, green roofs and walls, and street trees.



Hedgerows and areas of natural vegetation within agricultural areas provide habitat and support connectivity.

Strategy 3: Integrate Natural Assets into Conventional Asset Management and Decision-Making Processes

While ecosystems should not be considered solely as “assets” from which humans derive value, the concept of “natural assets” has emerged as a mechanism to highlight that ecosystems (e.g. a wetland) can be formally acknowledged as a fundamental asset that benefits the community - in the same way that engineered assets (e.g. a wastewater treatment plant) are recognized.

Natural assets provide an extensive range of ecosystem services which are not officially recognized in traditional asset management, financial planning, or decision-making processes. Integrating natural assets into asset management processes supports improved understanding of the services they provide, and this information supports efforts to maintain and manage natural assets for their long term health and resiliency. Ensuring these natural assets are protected and monitored over the long term is crucial in the context of a changing climate, since many of the services ecosystems provide help communities respond to climate change.

While the concept of natural asset management is gaining considerable traction at the local level, Metro Vancouver can also play a key role in managing regional assets, supporting regional partners, convening key groups, providing a discussion forum, and developing and sharing data. Collectively, the region can elevate natural asset management from an optional process to an integral one. While there is no way to place a true economic valuation on nature itself (nor should nature be valued this way), a more robust understanding of the location of natural assets and the level of services they provide helps to demonstrate their critical importance to our communities, and an additional tool to help protect, restore, and enhance them.

3.1 Incorporate Natural Assets Into Asset Management and Financial Planning.



Through implementation of the regional growth strategy, incorporate natural assets and ecosystem services into Metro Vancouver’s corporate planning, asset management systems and investments, and provide regionally appropriate guidance on methodologies, tools and decision-making frameworks. This Big Move will require multiple departments at Metro Vancouver to shift their standard practice, and collaborate across silos.

STRATEGY 3	Potential Impacts of Strategy	Key Partners
	<ul style="list-style-type: none"> • Elevates natural asset management as standard practice rather than the exception • Provides an additional mechanism to help protect nature and ecosystems long-term • Enables consistent funding opportunities 	<ul style="list-style-type: none"> • Member jurisdictions • First Nations • NGOs • BC government • Public Sector Accounting Board • Agricultural land owners

3.2 Integrate Ecosystems and their Services into the Design of Major Infrastructure.



Demonstrate leadership and innovation by integrating nature-based solutions into the siting and design of major infrastructure where appropriate (or “where it makes sense”), and consider nature-based complements to hard (or “grey”) infrastructure. Also require full carbon cost accounting and ecosystem service valuation during construction and operation of Metro Vancouver’s water and wastewater infrastructure.

3.3 Consider Ecosystems and their Services in Major Development Decisions.

Work with member jurisdictions to understand and consider ecosystems and their services, including carbon storage and flood protection, in major development decisions, such as regional growth strategy amendment decisions. Using appropriate data and other forms of knowledge, consider how potential new developments may inhibit the capacity for nature to provide ecosystem services and explore alternatives.

3.4 Support Natural Asset Management at the Local Level.

Develop and share guidance materials to support natural asset management at the local level, and provide a forum to share and advance best practices. Regional datasets can be used to inform local natural asset inventories including trans-boundary areas. Forums are a vital space to connect and empower local champions of natural asset management, build a regional network, and develop internal natural asset knowledge within organizations.

3.5 Explore Opportunities to Overcome Barriers to Natural Asset Management.

Explore the legal landscape and other barriers that may inhibit natural asset management in the Metro Vancouver region. Results from this research may reveal opportunities to further reduce barriers or enable strategic frameworks and norms that support natural asset management in the region and across BC.

Municipal Natural Assets Initiative (MNAI)

The [Municipal Natural Assets Initiative](#) provides scientific, economic and municipal expertise to support and guide local governments in identifying, valuing and accounting for natural assets in their financial planning and asset management programs, and in developing leading-edge, sustainable and climate resilient infrastructure. Local communities in the Metro Vancouver region have taken the lead in working with the MNAI to understand and advance natural asset management.

District of West Vancouver’s Natural Asset Inventory

The District of West Vancouver is one of the first Canadian municipalities to estimate the value of their natural assets in terms of the services they provide annually and into the future – a first step toward integrating natural assets into the District’s financial and asset management plans. Metro Vancouver provided its Sensitive Ecosystem Inventory data to support this process.



Strategy 4: Support a Resilient, Robust, and Healthy Urban Forest

The urban forest includes all of the trees in the public and privately owned lands of the built environment – including the trees in backyards, streets, and parks. A healthy and resilient urban forest provides essential ecosystem services such as habitat for local wildlife, shading and cooling hotter areas, capturing rainfall and stormwater, and storing carbon (the region’s urban forest currently stores approximately 8 million tonnes of carbon⁴). To implement this strategy, Metro Vancouver can establish a regional urban tree canopy cover target, improve tree canopy cover in Metro Vancouver-owned lands such as Regional Parks and Watersheds, and support member jurisdictions, stewardship groups, and other regional partners by developing and sharing relevant data and resources.

4.1 Achieve 40% Tree Canopy Cover Within the Region’s Urban Areas

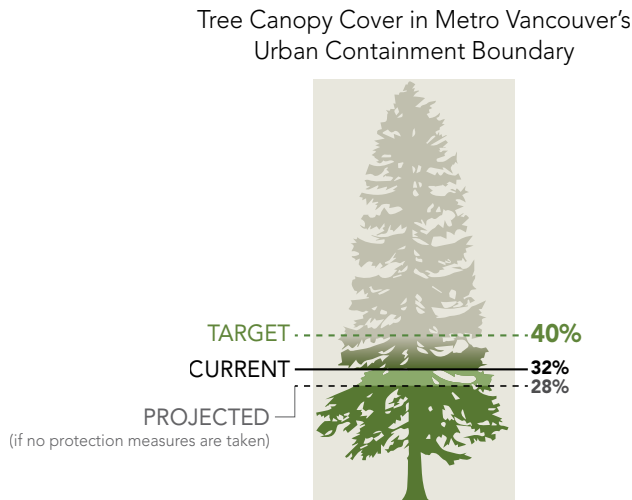


All member jurisdictions, through implementation of the regional growth strategy, will identify local tree canopy cover targets, and demonstrate how these targets will contribute to the regional target of 40% canopy cover within the region’s Urban Containment Boundary. Metro Vancouver will contribute to this target by increasing tree canopy on Metro Vancouver-owned lands (where applicable), measuring and reporting on regional tree canopy cover trends, and advocating to the federal and BC governments to provide suitable funding opportunities for tree planting in urban areas.

STRATEGY 4	Potential Impacts of Strategy	Key Partners
	<ul style="list-style-type: none"> Increases tree canopy cover to improve ecosystem services, including those that are climate change-related Improves the health and resiliency of the urban forest Provides a forum for knowledge sharing and partnerships 	<ul style="list-style-type: none"> Member jurisdictions Academic institutions Health authorities Urban forestry practitioners First Nations BC government Federal government Professional associations Local residents

⁴ Figure obtained from Metro Vancouver’s Carbon Storage Dataset (metrovancover.org/data).

FIGURE 8: TREE CANOPY COVER IN METRO VANCOUVER



Tree Canopy Cover and the 40% Target

Tree canopy cover refers to the leaves and branches that form a visible layer, and the extent to which they cover the ground if one is viewing from the air. Given the ecosystem services that trees provide, we often use canopy cover as a proxy for these services. The region's canopy cover within the [Urban Containment Boundary](#) is currently 32%, and this number is expected to fall to 28% in the next 20-30 years based on projected development patterns. A canopy cover target of 40% is commonly adopted at the local level in cities around the world, and this number represents both an aspirational and achievable goal for the Metro Vancouver region. Local variation in geography, environmental conditions and historical development patterns will need to be considered, given that a 40% target is a regional average that will not be feasible for every individual member jurisdiction to meet at the local level.

Reversing the current trend of tree canopy loss and meeting a 40% tree canopy target will require collaboration and commitment throughout the region, and a major shift in the way tree protection and planting efforts are prioritized. Strategy 4 outlines critical next steps to achieve this objective.

4.2 Provide Data and Resources to Support Urban Forest Management.

Continue to develop and share materials that support member jurisdictions and other partners in achieving a healthy and resilient urban forest. These materials can help support local and regional urban forestry objectives.

4.3 Improve Local Regulations and Management Practices.



All member jurisdictions, through implementation of the regional growth strategy, will enable the retention and expansion of urban forests using various tools, such as local tree canopy cover targets, urban forest management strategies, tree regulations, development permit requirements, land acquisition, street tree planting, and reforestation or restoration policies, with consideration of climate resiliency. Through best practices and new or updated regulations, member jurisdictions have an opportunity to support a healthy urban forest by protecting and retaining existing trees, and supplementing those actions with the planting of new trees.

4.4 Convene Partners on Urban Forestry Issues.

Continue to provide a forum for a diverse range of urban forestry practitioners to discuss and collaborate on issues of regional concern. These forums allow regional partners to learn from each other, share relevant information and updates, overcome barriers, and build a community of practice.

Metro Vancouver Corporate Leadership in Urban Forestry

Urban Forest Climate Adaptation Initiative

- Metro Vancouver developed the Urban Forest Adaptation Initiative to assess the risks and predicted changes to the region's urban forest. The initiative provides guidance to help practitioners manage urban forests in a changing climate today and to prepare for the future.

Regional Tree Canopy Cover and Impervious Surfaces Report - This report contains an analysis of tree canopy cover and impervious surfaces in Metro Vancouver, and is accompanied by two publically-available GIS datasets.

Metro Vancouver Tree Regulations Toolkit

- The Metro Vancouver Tree Regulations Toolkit identifies the available approaches to regulate trees in British Columbia, highlights considerations for selecting appropriate tools based on the local community context, and details the higher-level plans and local-scale regulatory tools that can help to preserve trees and increase tree canopy cover.

Encouraging Tree Planting and Green Infrastructure on Residential Properties

Metro Vancouver's 2019 Regional Tree Canopy Cover and Impervious Surfaces Report identified that within the Urban Containment Boundary, approximately 37% of potential planting area – land that could *theoretically* be used to increase tree canopy cover – is located in residential areas. This means that local residents can play a significant role in improving residential tree canopy cover within communities. Local governments can encourage environmental stewardship, partnership, and tree planting and protection on private properties through programs and initiatives, and communicate the benefits of trees.

While trees provide significant levels of ecosystem services, other types of green infrastructure provide benefits close to where people live as well. Metro Vancouver's [Grow Green](#) platform is a helpful guide to creating and maintaining a sustainable garden or lawn space on private property - utilizing non-invasive, waterwise plants that are readily available in Metro Vancouver.

4.5 Consider Equity and Human Health in Urban Forestry Planning.

Work with health authorities, academic institutions, member jurisdictions, and other partners to further understand the connections between urban trees, human health, and equity, and consider these factors in urban forestry planning. These connections are particularly important to understand in the context of a changing climate.

Strategy 5: Advance Nature-based Solutions to Climate Change

Nature-based solutions are actions that protect, sustainably manage, and restore ecosystems, as well as address societal challenges such as climate change, providing both human well-being and biodiversity benefits. These solutions can be an important part of climate action planning since the co-benefits extend beyond storing carbon and adapting to climate change impacts. Metro Vancouver can help advance nature-based solutions by integrating them into regional projects and plans, encouraging and supporting their uptake at the local level, and exploring new and innovative opportunities for this emerging area of practice.

5.1 Explore Innovative Funding and Incentive Programs.



Explore the viability of innovative financial and incentive mechanisms (such as nature-based carbon offsets and credits, conservation levies, green bonds, insurance-based funding, and payment for ecosystem services) to advance and support nature-based solutions. This Big Move also includes identifying existing funding sources, and advocating that the federal and BC governments enable and support nature-based solutions. This support could include providing reliable and sustainable funding sources and incentive programs for multiple ecosystem types and services. In addition to exploring partnership options, this Big Move will involve gauging public support for various options and determining appropriate implementation scales.

5.2 Plan for Climate Change Impacts on Ecosystems.



Work with other partners to conduct a vulnerability assessment of the region's ecosystems and update the Metro Vancouver Sensitive Ecosystem Inventory with climate change vulnerability information (e.g. impacts of coastal squeeze on intertidal ecosystems). This Big Move would create information that can be used across the region to inform planning efforts. It could also involve understanding how climate change impacts may affect carbon sequestration potential in the region's ecosystems.

5.3 Include Nature-Based Solutions in Climate Action Plans.

Advocate that member jurisdictions include nature-based solutions in climate action plans. Work with the federal and BC governments to identify opportunities to fund and implement nature-based solutions for climate change adaptation and carbon storage at the local level. Metro Vancouver will also provide data and a forum to share experiences and best practices.

Outcomes from action 5.1 may support implementation of other strategies and actions throughout the *Nature & Ecosystems Roadmap*.

STRATEGY 5	Potential Impacts of Strategy	Key Partners
	<ul style="list-style-type: none"> • Supports the research, uptake, and mainstreaming of nature-based solutions in climate action planning • Provides human health and biodiversity co-benefits 	<ul style="list-style-type: none"> • Member jurisdictions • First Nations • Academic institutions • BC government • Federal government • NGOs • Agricultural land owners

Nature-based Carbon Offsets and Credits

A carbon offset is a reduction in carbon (or an increase in carbon storage, e.g. through tree planting) that is used to compensate for greenhouse gas emissions that occur elsewhere. A carbon offset credit is a transferrable instrument certified by governments or other entities. These offsets and credits are transferred through markets – these markets exist under both **mandatory** (compliance) and **voluntary** programs, both of which require some form of verification.

- **Mandatory markets** are created and regulated by mandatory national, regional, or international carbon reduction programs.
- **Voluntary markets** function outside of compliance markets and enable the purchase of offsets on a voluntary basis.

Key Considerations for Carbon Offsets

- **Framing and Use:** Offsetting should be framed as an additional action to supplement deep reductions in greenhouse gases, rather than a compensating action that enables greenhouse gas emitting activities to continue business as usual.
- **Additionality:** Ecosystem protection/restoration to create the carbon offset must be an activity that would not have occurred without the offset – for instance, a forest that is already legally protected should not be counted in the offset process.
- **Permanence:** Ecosystems protected through offsets should be protected permanently. This can be difficult to ensure for some ecosystem types (e.g. salt marshes affected by sea level rise, and forests disturbed by pests and wildfire).
- **Leakage:** Preventing a harmful activity in one location may simply transfer that same activity to a new location – i.e. protecting a forest from logging may simply shift the activity to a new area, resulting in no net climate benefit.
- **Verification and quantification:** Given the complexity of carbon fluxes in natural systems, a project's greenhouse gas reductions must be quantified accurately and then verified by an accredited third party. Guidelines for quantification, verification, monitoring, and reporting are needed to ensure projects deliver the estimated carbon reductions. Verification methods for forest ecosystems are the most well-developed to date.

Future Work

Metro Vancouver will continue to monitor and explore the role and validity of nature-based carbon credits and offsets in the region, in addition to other innovative financial and incentive mechanisms that support nature-based solutions. Future work could also explore the role of alternative ecosystems (e.g. salt marshes) and ecosystem services (e.g. habitat, flood protection) in offset mechanisms, through mandatory, voluntary and regional scale markets.

5.4 Support the Implementation of Nature-based Solutions.

Work with academic institutions and other regional partners to explore and promote best practices and technologies for advancing innovative nature-based solutions, while ensuring risks are minimized. This action could also involve identifying legislative and other barriers to implementing nature-based solutions, and providing a forum for collaboration and knowledge-sharing with practitioners.

5.5 Manage Forests in the Context of a Changing Climate.

Advocate to the BC government to continue implementing measures that adapt forests to a changing climate (e.g. assisted migration research), enhance carbon storage (e.g. reforestation), and reduce greenhouse gas emissions associated with forest management (e.g. reduce slash pile burning). Continue to work with the BC government and local authorities in early detection and suppression of wildfire in the region's drinking water supply areas and adjacent forested areas, as well as fuel management practices in areas with high ignition risk.

Forest Fires and the Wildland Urban Interface (WUI)

Interventions to protect communities from wildfire risks will be explored further in the *Land Use and Urban Form Roadmap*.

5.6 Advance Nature-Based Solutions to Address Flood Hazards.

Work with partner organizations to advance cross-jurisdictional nature-based solutions for flood management, through processes such as the *Lower Mainland Flood Management Strategy* and the BC government's *Flood Strategy*.

5.7 Develop our Understanding of Coastal Ecosystems and Blue Carbon Potential.

Work with academic institutions and other regional partners to better understand the long-term health and carbon storage potential in the region's coastal and marine ecosystems, including tidal marshes, eelgrass and kelp. Researchers in the region are studying these ecosystems and filling data gaps, and Metro Vancouver will collaborate on next steps.

5.8 Partner with Others to Address Climate Change Issues in Coastal and Marine Ecosystems.

Work with Key Partners to address climate change issues in coastal and marine ecosystems. Given the complex overlapping jurisdictions that exist in the coastal and marine realm, action will require partnership and collaboration. Early opportunities include collaborating with the BC government on the proposed *Ocean Acidification and Hypoxia Action Plan* and *Coastal Marine Strategy*.

Climate Change and Marine and Coastal Ecosystems

Our rich marine and coastal areas provide important habitat for fish and wildlife including endangered killer whales, salmon, and hundreds of species of resident and migratory shorebirds. The ocean has spiritual, cultural and ceremonial value for local First Nations, and it provides traditional foods. Salt marshes and seagrasses can store carbon and mitigate flooding in coastal communities. However, these complex intertidal and marine ecosystems are particularly vulnerable to climate change. With rising seas and storm surge, intertidal wetlands will be lost as they are unable to move higher due to sea walls and other human-made structures. In marine environments, warmer temperatures, increased runoff from more extreme rainfall events, and changes in ocean chemistry will alter ecological processes.



Setting the Path Ahead

The “Setting the Path Ahead” section will eventually be found on Metro Vancouver’s Climate 2050 webpages under “Nature and Ecosystems”, and will serve as a companion to the *Nature and Ecosystems Roadmap*. This will allow Metro Vancouver to track progress towards targets, and add and adjust strategies and actions in response to performance measurement.

Nature and ecosystems are already providing critical ecosystem services that support climate action; locking away millions of tonnes of carbon in vegetation and soils, and moderating the impacts of a changing climate by reducing flooding, protecting shorelines, and cooling temperatures. However, natural systems are themselves at risk from climate change, land development, pollution, invasive species and other factors; these impacts reduce the ability of nature to provide important climate-related services.

In order to maintain the existing services provided by nature and prevent further losses, actions to protect nature and ecosystems need to be implemented

without delay. This involves protecting the region’s ecosystems, including the urban forest, and ecosystem connectivity across the region. These measures are supported by actions that seek to change how we do business by integrating nature into decision-making and managing natural assets for their long term health and resiliency. Actions to advance the understanding and mainstreaming of nature-based solutions are important to ensuring the region’s responses to climate change leverage the benefits provided by nature, while also supporting biodiversity and human health and well-being. Actions that support restoration and enhancement of ecosystems offer an opportunity to gain back lost ecosystem function and climate-related benefits.

The timeline below contains all of the actions included in this Roadmap. Although there is much work to be done, there are some critical actions that, if started over the next two years, will support the regional vision of a carbon neutral and resilient region by 2050. Many actions contained in the *Nature and Ecosystems Roadmap* will be initiated in the short-term, but benefits and outcomes will be accrued slowly over time as ecosystems mature.

CLIMATE 2050 NATURE AND ECOSYSTEMS ROADMAP ACTION TIMELINE

STRATEGY	2021-2023	2024-2029	2030-BEYOND
STRATEGY 1 Protect, Restore, and Enhance the Region's Ecosystems	1.1 BIG MOVE Protect an Additional 10% of the Region for Nature		
	1.2 Protect, Restore, and Enhance Natural Areas at the Regional Scale		
	1.3 Protect, Restore, and Enhance Nature at the Local Scale		
		1.4 Incorporate Climate Change Planning into Protected Area Management	
	1.5 Prioritize the Conservation of Ecosystem Health and Biodiversity in BC Forest Management		
	1.6 Support Ecosystem Protection, Enhancement, and Restoration		
		1.7: Reverse the Loss of the Region's Ecosystems through Restoration.	
	1.8 Manage invasive species		
STRATEGY 2 Connect Green Infrastructure	2.1 BIG MOVE Develop a Regional Green Infrastructure Network		
	2.2 Green Urban Areas		
	2.3 Green the Regional Greenways Network		
	2.4 Minimize Ecosystem Fragmentation		
		2.5 Develop Data and Resources to Support Ecosystem Connectivity	
STRATEGY 3 Integrate Natural Assets into Conventional Asset Management and Decision-Making Processes	3.1 BIG MOVE: Incorporate Natural Assets into Asset Management and Financial Planning		
	3.2 BIG MOVE: Integrate Ecosystems and their Services into the Design of Major Infrastructure		
	3.3 Consider Ecosystems and their Services in Major Development Decisions		
	3.4 Support Natural Asset Management at the Local Level		
		3.5: Explore Opportunities to Overcome Barriers to natural asset management	
STRATEGY 4 Support a Resilient, Robust, and Healthy Urban Forest	4.1 BIG MOVE: Achieve 40% Tree Canopy Cover Within the Region's Urban Areas		
	4.2: Provide Data and Resources to Support Urban Forest Management		
	4.3: Improve Local Regulations and Management Practices		
	4.4: Convene Partners on Urban Forestry Issues		
	4.5 Consider Equity and Human Health in Urban Forestry Planning		
STRATEGY 5 Advance Nature-based Solutions to Climate Change	5.1 BIG MOVE: Explore Innovative Funding and Incentive Programs		
		5.2 BIG MOVE: Plan for Climate Change Impacts on Ecosystems	
	5.3: Include Nature-Based Solutions in Climate Action Plans		
	5.4 Support the Implementation of Nature-based Solutions		
	5.5: Manage Forests in the Context of a Changing Climate		
	5.6: Advance Nature-Based Solutions to Address Flood Hazards		
		5.7: Develop our Understanding of Coastal Ecosystems and Blue Carbon Potential	
	5.8 Partner with Others to Address Climate Change Issues in Coastal and Marine Ecosystems		



Measuring our Progress

The table below lists examples of some of the performance indicators that could be used to help Metro Vancouver measure regional progress towards meeting the objectives of this Roadmap. Indicators in the table below may apply to more than one strategy, even if not listed. The performance indicators used will depend, to some extent, on the availability of this information from other organizations and agencies. Because this Roadmap allocates some actions to other partners, data sharing will be critical for measuring the pace of our collective progress towards common goals.

ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Protect, Restore, and Enhance the Region’s Ecosystems	Hectares of unprotected Sensitive or Modified Ecosystems	Metro Vancouver	Yes
	Hectares of protected lands and waters	Metro Vancouver	Yes
	Hectares of Sensitive or Modified Ecosystems	Metro Vancouver	Yes
	Percent of inventoried Sensitive or Modified Ecosystems rated high quality	Metro Vancouver	Yes
	Hectares of ecological restoration areas	Metro Vancouver Member jurisdictions NGOs BC government Other agencies	Yes – regional parks No – rest of region
	Number of new invasive non-native species recorded and/or considered established	BC government Federal government	Yes
	Watershed and stream health index	Metro Vancouver	No



ROADMAP ELEMENT	KEY PERFORMANCE INDICATOR	DATA SOURCE	DATA IS CURRENTLY COLLECTED
Connect Green Infrastructure	Ecosystem connectivity index	Metro Vancouver	No
	Percent impervious surfaces (e.g. paved roads, buildings)	Metro Vancouver	Yes
Integrate Natural Assets into Conventional Asset Management and Decision-making Processes	Carbon stored in vegetation and soils	Metro Vancouver	Yes
	Measurement of ecosystem services (T.B.D.)	T.B.D.	No
	Number of member jurisdictions with natural asset inventories	Member jurisdictions	No
Support a Resilient, Robust, and Healthy Urban Forest	Percent tree canopy cover (for the region and the urban containment boundary)	Metro Vancouver	Yes
	Urban forest health assessment	T.B.D.	No
	Number of member jurisdictions with current (<=5yrs) tree bylaws and/or urban forest management strategies	Member jurisdictions	Yes
	Number of member jurisdictions with tree canopy cover targets	Member jurisdictions	Yes
Advance Nature-based Solutions to Climate Change	Number of member jurisdictions' climate plans that incorporate nature-based solutions	Member jurisdictions	No
	Extent of coastal ecosystems	BC government NGOs Academic institutions	No
	Ecosystem vulnerability indicators (T.B.D.)	T.B.D.	No

Metro Vancouver will continue to develop indicators as new information becomes available, and technological advances are made.

Glossary

Air contaminants refer to any substance that is emitted into the air and that (a) injures or is capable of injuring the health or safety of a person; (b) injures or is capable of injuring property or any life form; (c) interferes or is capable of interfering with visibility; (d) interferes or is capable of interfering with the normal conduct of business; (e) causes or is capable of causing material physical discomfort to a person; or (f) damages or is capable of damaging the environment.

Biodiversity is the variety of species and ecosystems, and the ecological processes that they are part of.

Blue carbon refers to the carbon stored in coastal and marine ecosystems.

Blueway refers to a network of water bodies (such as rivers, creeks and lakes), often used for recreation.

Carbon neutral region is a region that has achieved the deepest greenhouse gas emission reductions possible across all economic sectors, and removes or captures sufficient carbon dioxide to balance any remaining regional greenhouse gas emissions.

Carbon sequestration is the removal of carbon dioxide from the air on an annual basis.

Carbon storage refers to the total amount of carbon stored in the vegetation and soils of ecosystems such as forests, wetlands and intertidal areas, which often takes thousands of years to accumulate.

Climate change adaptation means anticipating, planning for, and responding to the adverse effects of climate change and taking appropriate action to prevent or minimize the damage it can cause, or taking advantage of opportunities that may arise. It has been shown that well-planned, early adaptation action saves money and lives later.

Climate resilience describes the capacity of ecosystems, economies, infrastructure, and communities to absorb the impacts of climate change while maintaining essential services and functions needed to support health and well-being. In some cases, climate resilience involves changing services and functions so they are more sustainable.

Coastal squeeze occurs when rising sea levels push coastal habitats landward. Coastal habitats are often diminished in both size and function when caught between rising sea levels and fixed infrastructure (such as a sea wall) or high ground.

Ecological health captures the connection among healthy functioning ecosystems, the valuable services they provide, and human well-being.

Ecosystems are all the plants and animals that live in a particular area together with the relationships between them and their environment.

Ecosystem connectivity is the physical and functional links between ecosystems that support biodiversity by allowing movement of species across the region.

Ecosystem services are the benefits people obtain from ecosystems, including food, fresh water, shading, and human health and well-being. These services can be grouped into four main types: supporting, provisioning, cultural, and regulating.

Equity is the promotion of fairness, justice, and the removal of systemic barriers that may cause or aggravate disparities experienced by different groups of people. This can include consideration of the many dimensions of identity, such as socioeconomic status, race, ethnicity, sex, age, disability, gender, sexuality, religion, indigeneity, class, and other equity-related issues.

Fine particulate matter (PM_{2.5}) is made up of tiny solid or liquid particles that float in the air and can penetrate deep into the lungs and even into the bloodstream. Fine particulate matter can damage people's health by aggravating existing lung and heart diseases, increasing the risk of cancer and reducing life expectancy.

Green gentrification occurs when improvements to urban green space trigger a flow of wealth into an area, increasing the cost of living and forcing economically marginalized residents to relocate.

Green infrastructure is the natural, enhanced, and engineered assets that collectively provide society with ecosystem services required for healthy living.

Greenhouse gases are air contaminants that trap heat and are the cause of climate change. Greenhouse gases include carbon dioxide and nitrous oxide, as well as short-lived climate forcers such as methane, halocarbons, black carbon and ozone. Limiting or preventing greenhouse gas emissions and removing these gases from the atmosphere is critical to avoiding catastrophic climate change (sometimes referred to as climate change mitigation).

Ground-level ozone (O₃) can have harmful impacts on everyone, especially children, seniors, and people with lung and heart conditions. It is primarily formed when nitrogen oxides and volatile organic compounds react in the air on hot and sunny days.

Hazard refers to a dangerous phenomenon, substance, human activity, or condition. In this context, hazards are caused or made worse by climate change. Examples include rainstorms, extreme weather, wildfires, storm surges, and landslides.

Impacts refers to the consequences of realized risks on ecosystems, economies, infrastructure and communities. Impacts may be referred to as consequences or outcomes, and can be adverse or beneficial.

Indigenous Knowledge reflects the unique cultures, languages, governance systems and histories of Indigenous peoples from a particular location. Indigenous knowledge is dynamic and evolves over time. It builds on the experiences of earlier generations and adapts to present conditions. First Nations, Inuit and Métis each have a distinct way of describing their knowledge. Knowledge-holders are the only people who can truly define Indigenous knowledge for their communities.

Keystone species have a disproportionately large effect on the ecosystems in which they occur. Keystone species help to maintain local biodiversity within a community either by controlling populations of other species that would otherwise dominate the community, or by providing critical resources for a wide range of species.

Natural assets are the stock of natural resources and ecosystems (including geology, soil, air, water, and all living things) that provide benefits to people. Examples include forests, wetlands, aquifers and streams. It is from these natural assets that humans derive a wide range of services, often called ecosystem services, which make human life possible.

Nature-based solutions are actions that protect, sustainably manage, and restore natural or modified ecosystems but also address societal challenges (such as climate change), thereby providing both human well-being and biodiversity benefits.

Recreational Greenway refers to a linear corridor often used for recreation.

Regional Greenways Network is the region's network of recreational greenways which support recreational walking, cycling, and, where appropriate, horseback riding.

Riparian refers to areas close to or on river banks.

Sensitive Ecosystem are ecosystems mapped by the Metro Vancouver Sensitive Ecosystem Inventory. Sensitive Ecosystems are ecologically significant and relatively unmodified, and include wetlands, older forests and riparian areas. Some younger and more human modified ecosystems still have ecological value and importance to biodiversity (e.g., young forests), and are also included in the Sensitive Ecosystem Inventory.



Stormwater is the water from rain or melting snow that is not absorbed into the ground. In urban areas, stormwater goes into storm sewers (the grated drains found on streets), which empty directly into rivers, creeks or the ocean. Managing stormwater and drainage is key to preserving the health of urban streams and rivers.

Subsidence is the sudden sinking or gradual downward settling of the ground's surface. Subsidence is common in river deltas.

Tree canopy cover refers to the leaves and branches that form a visible layer if one is viewing the region from the air, and the extent to which they cover the ground.

Urban forest refers to the trees within the public and private lands of a city, including the trees in parks, around buildings, along streets and in backyards.

Urban heat island effect refers to a phenomenon where built-up areas are hotter than nearby non-urban areas. The average air temperature of a city can be several degrees warmer than the surrounding landscape.

Vulnerability is the degree to which ecosystems, economies, infrastructure and communities are susceptible to, or unable to cope with, the adverse effects of climate change. Vulnerability varies based on exposure, sensitivity and adaptive capacity. Geographic location, socio-economic conditions, and other factors can impact susceptibility to harm and adaptive capacity.

