CITY OF NORTH VANCOUVER

BIODIVERSITY AND NATURAL AREAS REPORT

Report by Diamond Head Consulting

March 2023

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TRADITIONAL ACKNOWLEDGEMENTS

We recognise and respect that the City of North Vancouver is on the unceded and unsurrendered land of Sḵwx̱wú7mesh Úxwumixw (Squamish Nation) and səlilwətaɬ (Tsleil-Waututh Nation). The City recognizes that these nations were stewards of this land for thousands of years and managed it to sustain its rich natural resources.

ACKNOWLEDGEMENTS

The lead Consultant that developed this report was Diamond Head Consulting Ltd. The following City departments and committees provided input, feedback, and support for this project and consultation process.

- The City's Climate and Environment Task Force
- The City's Engineering, Parks and Environment department
- The City's Planning and Development department

Aerial view of the City of North Vancouver.

1.0 EXECUTIVE SUMMARY

The City's natural areas connect to the vast wilderness of the North Shore Mountains and provide habitat for a diversity of wildlife and plant species. The trees, gardens, and landscaped areas within the City's developed areas also provide habitat for wildlife species that have a higher tolerance to live among us. These natural elements perform critical services that help manage the extreme weather events that are expected as our climate changes. They absorb and filter stormwater, provide shade in the summer months, and mitigate noise and air pollution. The City's urban forest absorbs carbon dioxide from the atmosphere, which helps to balance the City's carbon emissions, thereby reducing the impacts of climate change. Natural areas also provide recreational opportunities for residents and visitors. This has been shown to improve their health and well-being. The urban forest also provides educational opportunities to learn about our natural world and to interact with local wildlife.

The integrity of these natural areas, however, is being put under increasing stress from their popularity as well as the impacts of climate change including drought, pests, and diseases. The City of North Vancouver recognizes that integrating healthy, intact natural ecosystems is important to ensure the City remains resilient and sustainable. It is taking measures to improve biodiversity and the state of its natural areas through the development of this Biodiversity and Natural Areas report. This report will work to conserve the integrity of natural areas in the city through the protection and enhancement of ecologically sensitive, rare, and vulnerable areas. The report also recognizes the contributions that natural features have within active parks and urban areas and their role in protecting biodiversity and attracting wildlife to areas where residents can coexist with them. This Biodiversity report provides recommendations for operations, planning, and policy that will protect, connect, and restore the existing natural area assets and ensure that they will continue to be an integral part of the City's character.

A range of recommendations are provided in this report. These include actions related to policy, planning, operational systems, and public education. Some recommendations are easily implemented while others may take a long time to adopt. The following are high level goals that have been adopted to direct these recommendations and are referenced in the Draft Climate and Environment Strategy.

GOAL 1 *Protect natural area parks in the City from the impacts of adjacent development and recreational activities*

GOAL 2 *Restore areas in natural areas parks that have been degraded*

GOAL 3 *Protect water quality in freshwater streams and enhance the habitat they provide for fish populations*

GOAL 4 *Encourage wildlife movement across the City by acquiring and restoring corridors identified in the Natural Habitat Network*

GOAL 5 *Increase the diversity and cover of trees, ground vegetation and habitat features in urban parks*

GOAL 6 *Design and enhance greenways to include continuous cover of tree canopy and ground vegetation*

GOAL 7 *Encourage residents to install trees and ground vegetation, water sources and nesting sites for wildlife*

GOAL 8 *Develop planning policy that will promote green buildings designed to minimize their impact on wildlife*

GOAL 9 *Naturalize the marine foreshore, where possible, through the installation of trees and vegetation and engineered habitat features*

GOAL 10 *Educate the public on the benefits of natural areas and encourage stewardship of natural areas, watercourses, and wildlife*

GOAL 11 *Monitor the state of natural elements that indicate the health of ecosystems and biodiversity to evaluate the effectiveness of the City's environmental policies*

GOAL 12 *Review and update City policy to improve the protection and enhancement of natural areas*

2.0

Aerial view of west Lonsdale.

INTRODUCTION

The City of North Vancouver was once home to vast tracts of natural diversity where old-growth forest mountainsides met with the rich marine estuaries of the Burrard Inlet. This productive land was both beautiful and desirable for the resources it provided. The City has since developed into an urban hub that is still characterized by its natural environment. These rich natural areas support high levels of biodiversity, provide high-value recreation opportunities, and are deeply valued by the community for the range of benefits they provide. The integrity of these natural areas, however, is being put under increasing stress from their popularity as well as the impacts of climate change including storm events, heat and drought as well as pests and disease outbreaks.

Natural areas and features help to absorb and filter stormwater, provide shade in the summer months, dampen urban noise, and reduce air pollution.

The City recognizes that the integration of healthy, intact natural ecosystems is an important part of ensuring it remains resilient and sustainable. The City's natural areas connect to the vast wilderness of the North Shore Mountains and provide habitat for a diversity of wildlife and plant species. The trees, gardens, and landscaped areas within the developed areas of the City provide habitat for certain species that have a higher tolerance to live with us. These natural areas and features also perform important services that help manage the extreme weather events that are expected as our climate changes. They help to absorb and filter stormwater, provide shade in the summer months, dampen urban noise, and reduce air pollution. The City's urban forest absorbs carbon dioxide from the atmosphere which helps to balance the City's carbon emissions, thereby reducing the impact of climate change.

These natural areas provide recreational opportunities for residents and visitors, which has been shown to improve the health and well-being of residents. They also provide educational opportunities to learn about our natural world and to view and experience local species. Protecting and enhancing the City's natural areas and integrating natural features into our developed landscapes will help the City to prepare for and be resilient to our future climate.

What is Biodiversity and why is it important?

The term biodiversity describes the number and variety of species that inhabit an area. Areas with high levels of biodiversity generally provide food and protection for species throughout the food web, extending from the soils underground and up into the tree canopies. Biodiversity is sometimes used as an indication of the health and integrity of ecosystems. The level of biodiversity generally increases with the size and connectivity of an area, the diversity of habitat features that are present, the abundance of different types of food, protective cover, and access to water. In urban landscapes, biodiversity is generally lower as natural areas and features are replaced with hardened infrastructure. Natural areas can become fragmented, reducing the resources available to different species and causing inbreeding of isolated populations. As the City is planning for the future, there are opportunities to protect the remaining natural areas and the wildlife they support. Planning for biodiversity should focus on the enhancement of existing natural areas and creating new habitat features that are missing from the landscape.

COMPONENTS OF BIODIVERSITY AND NATURAL AREAS IN NORTH VANCOUVER

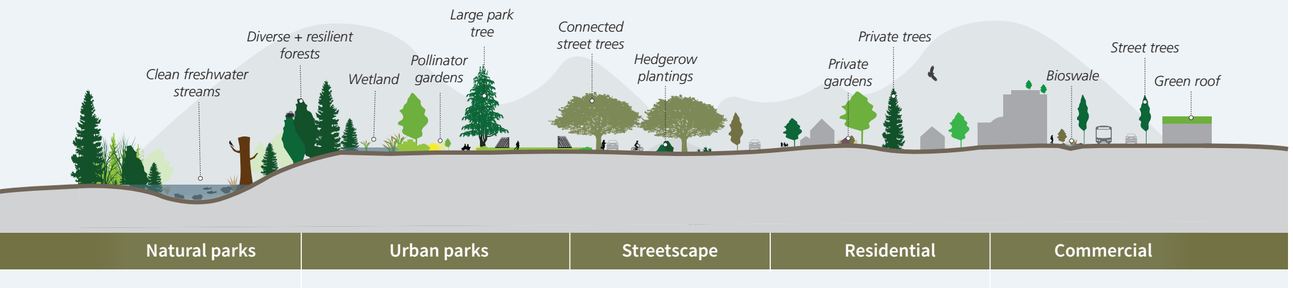


Figure 1. Land use types found in the City and components that contribute to biodiversity.

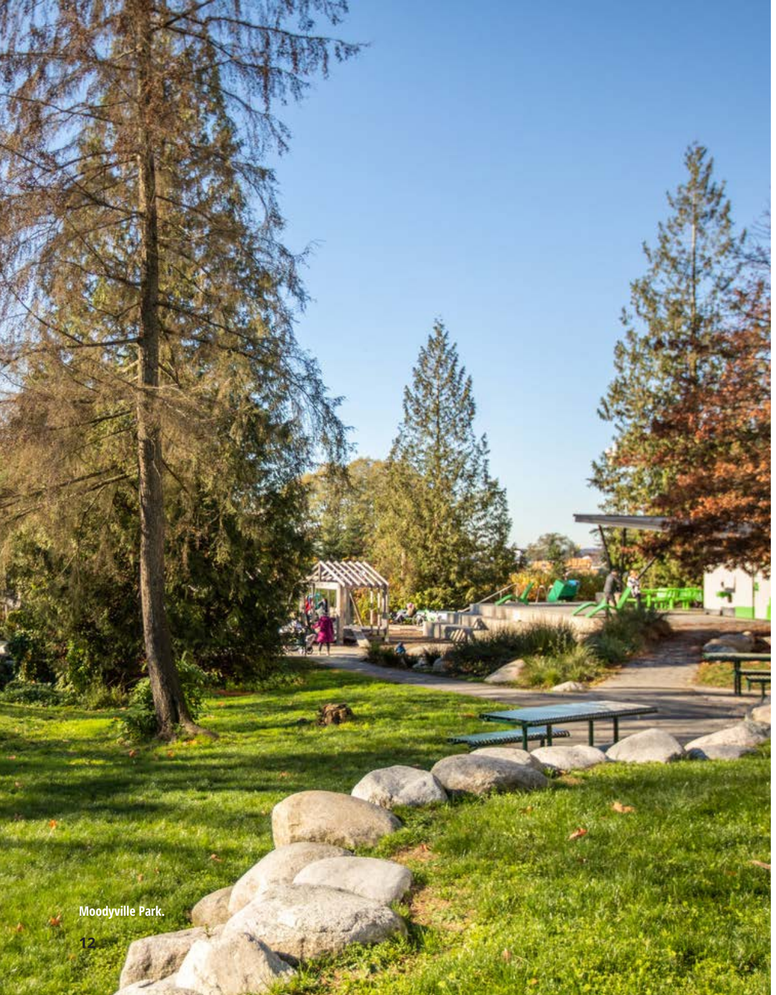
The City's Biodiversity Policy

Planning to protect biodiversity and integrating natural features and functions within cities has shown significant benefits for the economic and social well-being of citizens. The protection of environmentally sensitive areas and management of the associated benefits and risks of natural features is a priority for the City of North Vancouver. The City is developing a Climate and Environment Strategy (CES) which provides a vision for planning a City that is healthy and resilient to the changes in our climate.

"A resilient and low carbon community where all people and nature thrive"

Managing the future of the City to protect and enhance natural areas and the biodiversity that they provide supports many of the action items and goals of the Climate and Environment Strategy which include carbon reduction and storage, protecting watersheds, enhancing natural systems, and expanding and protecting the urban forest.

The City continues to grow as an urban hub, attracting people to work, live, and play. It is desirable for many reasons, including its proximity to a variety of natural environments. Growth of the City, however, requires densification which typically causes the loss of spaces for plants, trees, and wildlife. To preserve biodiversity within the City, these impacts can be compensated for by protecting and enhancing areas designated for wildlife and natural processes. These measures target both natural areas as well as integrating green infra-structure into new developments.



Moodyville Park.

The City is taking measures to improve biodiversity and natural areas through the development of this Biodiversity and Natural Areas report that will align with the long-term visions outlined in the City of North Vancouver's Official Community Plan (OCP). This report will be consistent with and support the CES's vision for a resilient and sustainable future. It will assist in reaching this vision by conserving the integrity of natural areas in the city through the protection and enhancement of ecologically sensitive, rare, and vulnerable areas. The OCP also recognizes the contributions that natural features within active parks and urban areas provide to protect biodiversity and to attract wildlife to areas where residents can coexist with them.

This Biodiversity report provides recommendations for operations, planning, and policy that will protect, connect, and restore the existing natural area assets and ensure that they will continue to be an integral part of the City's character.

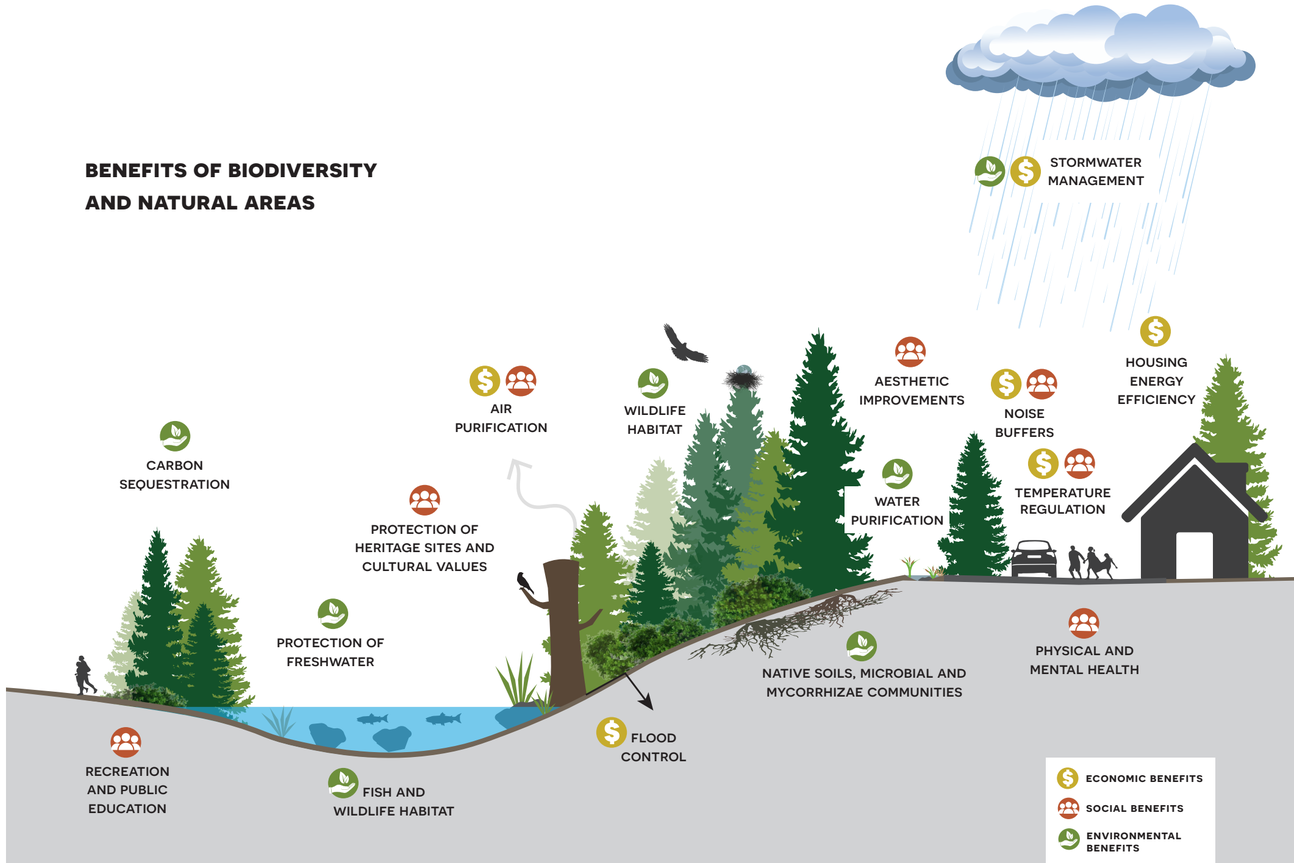


Figure 2. The benefits of biodiversity to the City.

3.0

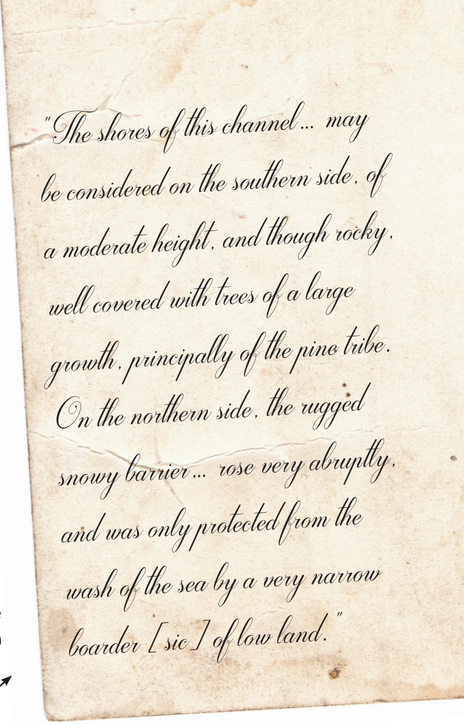
Delegation of Coast Salish leaders, circa 1908. (North Vancouver Archives, 15860)

WHAT DID THE CITY OF NORTH VANCOUVER LOOK LIKE BEFORE URBANIZATION?

The City of North Vancouver is intimately connected with its surrounding natural environment. The City is located on the productive lower slopes of the northern coastline of the Burrard Inlet, a relatively shallow-sided fjord approximately 16 kilometres long and 3 kilometres across at its widest point. This landscape features beautiful and desirable conifer forested mountainsides that connect the rich marine estuaries up to the alpine of the coastal North Shore Mountains. The City is situated between two glaciated valleys known as the Capilano and the Lynn and Seymour canyons. The region is within the wettest and most productive climatic zone in British Columbia. Heavy precipitation and moderate temperatures define this region as a temperate rainforest providing the productive growing condition to support it's lush forests.

Located near major waterways such as the Fraser River, Strait of Georgia, Howe Sound, Burrard Inlet, and their tributaries, the Vancouver region has been a place of meeting, trade, and settlement for thousands of years. Before European settlement, the Burrard Inlet was an important source of fish, shellfish, seaweed, and plants for Sḵwx̱wú7mesh Úxwumixw (Squamish Nation), səlilwətaɬ (Tsleil-Waututh Nation), and xwməθkwəy̓əm (Musqueam Nation). The mountains provided land to hunt, practice spiritual pursuits, and gather local plants and rocks.

Squamish First Nations from the Homulchesan village (xwemelch'stn) were the first to meet Captain George Vancouver at the mouth of the Capilano River on June 13, 1792. Captain George Vancouver described it in his diary.



European settlers recognized the abundant natural resources of this area and quickly worked to establish a diversified economy based on shipping (grain, lumber, and ore), shipbuilding and sawmilling, and light manufacturing. Sawmills were the first form of industry set up by the settlers on the North Shore of the Burrard Inlet in an area that is now known as Moodyville. Water and power to operate the mill was sourced from Lynn Creek, located just a few kilometres east.

Top: South Yard of Burrard Dry Dock, circa 1944. Middle: The heavily logged North Shore with Moodyville Mill on the right, circa 1898. Bottom: Aerial photo of Burrard waterfront during wartime, circa 1944.

"When the tide went out, the table was set".

–A saying amongst coastal First Nations to recount how much of their sustenance came from the ocean.

The mill started in 1863 and quickly and successfully expanded to foreign markets in 1865 due to the global desire for high-quality timber. The first settler community on the North Shore was composed of people who had jobs associated with the mill. Expansion continued as more timber leases were granted and telegraph and electricity lines were expanded.

The District of North Vancouver was established in 1891 and included all of the territory along the northern shore of the inlet except for Moodyville. In 1907, the City of North Vancouver was incorporated as an enclave within the district and in 1915, the City annexed Moodyville.

Before the turn of the century, the self-contained community of Moodyville had developed the foreshore into a functioning town. Small boats and schooners brought in supplies from the nearby farming areas of Lulu Island and the Fraser Valley. Land speculation gradually replaced timber exporting as the primary regional activity as the mill felt the effects of the worldwide depression, depletion of high-quality timber, and larger mills on the Fraser River became more competitive with rail access. When the mill officially closed in 1901, the region developed a commercial and residential hub near Lonsdale Avenue where the new Vancouver-to-north-shore ferry terminal was located. By 1925, the Moodyville townsite was fully incorporated into the City of North Vancouver.

A rail-to-road route to the North Shore was created following the completion of the Second Narrows Bridge in 1925. The former waterfront turned into an industrial zone of shingle mills, lumber yards, and grain elevators. Shipbuilding became a major source of employment during the First World War when Wallace Shipyards was contracted to build cargo schooners and freighters. During the Second World War, the Burrard Dry Dock Company, formerly known as Wallace Shipyards, expanded along the Burrard waterfront and became the busiest shipyard in Canada to assist in meeting the wartime demand for ocean vessels. In 1997, the City of North Vancouver began initial steps to transition the waterfront into mixed-use developments providing residential, commercial, and public amenities to the highly industrialized region.

Moodyville Sawmill Co. 1882-1900. (North Vancouver Archives, 6604)

4.0

Mosquito Creek

THE CITY'S ENVIRONMENTAL PROTECTION POLICY

The City of North Vancouver recognizes that the integration of healthy, intact natural ecosystems will ensure that the City remains resilient and sustainable. It has a long history of policy and planning that protect its natural area parks. The City has achieved this through their OCP; specifically, through Development Permit Areas (DPAs), policies, guidelines, and management plans. The City has adopted and enforced the following policies to protect the natural environment.

Stream and Drainage System Protection Bylaw (2003)

Soils are often exposed during construction works. These can erode and end up in catch basins, storm sewers and streams. When water is cloudy with sediments it can be detrimental to fish health. This bylaw includes requirements for controlling erosion and sediments during development ensuring that watercourses and fish populations remain healthy. Requirements in this bylaw include criteria for water quality upon discharge, development of erosion and sediment control plans and monitoring during construction.

Streamside Protection Guidelines (2006)

The City has developed Development Permit Areas for the protection of streams. This Streamside DPA aims to protect fish, streams, and the setbacks adjacent to streams known as riparian areas. It was developed to ensure that all development meets or exceeds the provincial regulations, known as the Riparian Areas Protection Regulation (RAPR).

The DPA policy provides a cohesive process for landowners to understand the legal requirements of protecting riparian areas and a mechanism for the City to approve developments near riparian areas. This DPA process is triggered for any development proposed within 15 meters of the top of bank of a stream (10 m if the stream is in a wide ravine). Developments are allowed but must have no net loss of riparian habitat and must be located as far away from the stream as possible.

Park Master Plan (2010)

A Parks Master Plan guides the planning of natural areas and community and neighbourhood parks in the City. It provides direction for design, protection, and acquisition as well as the amenities provided by these parks. More specific management plans have been developed for individual parks. These management plans consider the environmental and recreational assets of the parks. Management recommendations follow the City of North Vancouver's vision of a sustainable, healthy, and resilient City and establish goals to help improve biodiversity and environmental protection while providing recreational access and opportunities.

Cosmetic Pesticide Use Control Bylaw (2010)

This bylaw restricts the use of pesticides for cosmetic purposes on both private and public lands in the City. This includes substances that are used to control insects, weeds, rodents, fungi, and bacteria. This bylaw allows for a permit to use pesticide as long as an Integrated Pest Management Program is in place that ensures that alternative methods are used prior to using the pesticide. Pesticides listed in Schedule 2 of the Provincial Integrated Pest Management Program are excluded from the bylaw.

Climate Change Adaptation Plan (2013)

A Climate Change Adaptation Plan was finalized in 2013. This plan looked to understand the changing climate in the City, develop projections, and understand the anticipated impacts of climate change. It uses this information to develop a vision, goal, and guidelines for the City's response to the changing climate, as well as objectives and actions for the City to take to mitigate the anticipated impacts. This strategy aims to "increase the City's resilience to the physical, social, economic, and environmental impacts of climate change".

Invasive Plant Management Strategy (2013, mapping update 2020)

Invasive plant species pose a significant risk to ecosystem health, biodiversity, and infrastructure. The Invasive Plant Management Strategy was developed to provide the City with a coordinated approach to managing invasive plant species. The Strategy has five main goals and objectives: Outreach and Education, Control Implementation, Stakeholder Coordination, Assessment and Restoration, and Policy and Adaptive Management. This Strategy is an integrated process that addresses the importance of managing invasive plant species and highlights the large role that the public plays. Effective invasive species management requires education and outreach for increasing public awareness and knowledge. In 2020, an update was conducted to survey the current abundance and distribution of invasive plant species on City property and determine whether invasive plant control programs in the City have been successful.

Integrated Stormwater Management Plan (2016)

The City has developed an Integrated Stormwater Management Plan (ISMP). The ISMP is a comprehensive plan that documents water flow throughout the City, both in natural streams and in engineered infrastructure. It provides long-term planning goals and objectives to improve water quality and reduce the impacts of storm surges. This plan encourages the use of green infrastructure, which are more naturally designed systems, to capture and slow stormwater flow. Examples of green infrastructure include bioswales, green roofs, pervious paving surfaces, and systems to capture and reuse grey water.

Tree Policy for Management of Trees on City Property (2011) and Tree Bylaw (2022)

The City of North Vancouver has a tree policy that outlines the management of trees on City-owned property. It aims to prioritize the preservation of existing trees wherever conditions permit. Tree Bylaw No.8888 has recently been adopted by Council for the protection and regulation of trees in the City. The Tree Bylaw outlines permitted reasons for the removal of trees, establishes a permitting process for tree removals on multi-family residential, commercial, civic, industrial, and mixed employment areas in the City, and details penalties for infractions. Properties that are zoned as single-family or duplex are currently excluded from the Tree Bylaw.

Climate and Environment Strategy (ongoing)

A Climate and Environment Strategy is currently under development and is planned to be completed in 2023. This strategy aims to address the impacts of climate change, some of which include hotter and drier summers, increasing wildfires and droughts, and wetter winters. The strategy will provide "a vision for a resilient and low carbon community where all people and nature thrive", "goals to help support the vision and respond to climate and nature crises", and "strategies to cut carbon pollution and promote a healthy environment". This biodiversity and natural areas report will inform the targets, goals, and actions to improve the resilience of ecosystems in the City.

Urban Forest Plan (ongoing)

An urban forest management plan was developed for the City in 2007. This plan was developed to document the natural condition of parks in the City, identify degradation and the sources of these impacts, and prescribe ways to maintain the ecological integrity, healthy, and vigour of park ecosystems. A new Urban Forest Plan is being developed and is planned to be complete in 2023. The purpose of this project is to establish a baseline of information to formulate actions and timelines needed to enhance and preserve the City's urban forest and to achieve the goals in the City's Draft Climate and Environment Strategy, and to align with Metro Vancouver's 2050 climate targets. This updated plan will help to guide decision making and best practices for the City's urban forest for the next 30 years.

Invasive species removal underway in Greenwood Park.

5.0

Aerial view of north Grand Boulevard.

BIODIVERSITY IN THE CITY OF NORTH VANCOUVER

The west coast of British Columbia is considered a rainforest. It has historically received high amounts of precipitation and the growing seasons have been long. Soils are generally rich in nutrients and provide abundant moisture which creates excellent growing conditions for plants and trees. The old-growth forests that once existed here were dense and lush, and contained some of the tallest trees in the world. These forests connected the ocean with the alpine of the North Shore Mountains and provided a range of habitat elements. Nutrient and habitat-rich streams supported resident and migratory fish species. Forests consisted of large and long-lived conifers that when they finally died, would remain standing and as they decayed. This created large openings in the forest canopy allowing sunlight to stream down to the forest floor. Ground vegetation responded to this light, growing into dense thickets of various species providing berries, seeds, and nuts as food sources for wildlife. These trees also provided shelter and food for wildlife, ranging from small mammals such as the Douglas and flying squirrels, to black bears that would overwinter in hollowed-out cavities. Woodpeckers like the impressive pileated woodpecker and northern flicker, and smaller birds such as chickadees and nuthatches, lived in cavities throughout these trees. When these dead trees eventually fell, they continued to provide habitat by creating long corridors of cover for ground species including a variety of shrews, mice, and voles. These fallen trees become what are known as nurse logs, providing growing conditions for many plant and tree species including red huckleberries and western hemlock trees. Many of these old nurse logs remain in the City's parks and continue to act as a growing medium for a variety of species.

The original old growth forests were harvested in the City at the turn of the last century. They regenerated naturally and have grown into productive mature

Barred Owl is a common owl in the forest of North Vancouver.

forests and are protected within City parks. These areas are now fragmented from each other by the urbanized landscape. When natural areas become isolated from the surrounding natural landscape, the species of plants and animals that live there are limited to using only the resources provided by that patch of habitat. If their populations are small in numbers, they can become unhealthy over time through inbreeding.

The rich growing conditions on the North Shore, the many habitat elements these areas provide, and access to both streams and marine areas still allow this modified environment to support a high diversity of wildlife species.

The lower mainland is located along an important migratory flyaway for many bird species. Some birds stop over in the lower mainland on their way further north to the arctic or south to as far as South America. The forests and marine foreshore area provide an important food source for these migrating birds. In the summer, many of the bird species that live here take advantage of our rich ecosystem while the weather is warm and then head back south for the winter months.

Residential neighbourhoods in the City provide suitable habitat for species that are more tolerant of human presence or can make use of small habitat features. This includes gardens, hedges, and urban trees. In general, the species that inhabit these urban areas include mostly birds, small mammals, and insects. Collectively, these fragmented and altered habitats are known as the “Urban Matrix.”

The remaining natural areas in the City are predominately protected within parks. These include linear parks that follow freshwater fish-bearing streams including Mackay, Mosquito, Mission, Wagg, and Lynn Creeks. Other large forested parks include Greenwood and Loutet Parks. Some natural areas in the City are smaller, more fragmented, and impacted by urban development such as Moodyville, Highplace, Kealy, Eastview, Tempe Heights, and Sunrise Parks.

Aerial view of Wagg Creek Park.

Northern flicker is a common woodpecker in the City.

Open space parks have been developed for recreation and provide fragmented habitat areas such as large urban trees and landscaped gardens. Some of the larger and most popular urban parks include Grand Boulevard, Victoria, and Waterfront Park.

The marine foreshore, although highly disturbed for industrial activities, is a significant ecological feature that characterizes the City. In recent years, efforts have naturalized some areas of this foreshore and provided access to residents. The Spirit trail crosses the City along the waterfront and is associated with several open space parks including Kings Mill Walk Park and Waterfront Park. The eastern part of the City's waterfront remains industrialized for use by the port for rail and deep-sea transport.

Natural Areas Inventory

Natural areas in the City were inventoried and mapped to understand their characteristics and capacity to support biodiversity. Areas with similar ecological characteristics were delineated by comparing collected attributes such as soil conditions, ecosystem classification, tree species, stand structure, and ground vegetation. Streams were mapped and reaches were classified based on their ability to support fish species. In addition to natural areas, partially natural or disturbed areas were also inventoried. This includes areas invaded by non-native species or those which have been impacted by urban encroachment.

A large dead standing tree provides valuable habitat for wildlife

In 2021, the City parkland that is in a natural state totals 87 ha which covers approximately 7% of the City. Two thirds of these parks are forested with second growth stands of trees. The proportion of forests dominated by coniferous trees, deciduous trees, or mixed species is illustrated in Figure 3. The remaining one third of the park areas are urban parks designed for passive recreation and include turf grass, urban trees, and fragmented landscaping. The distribution of these habitat types are mapped in Figure 4.

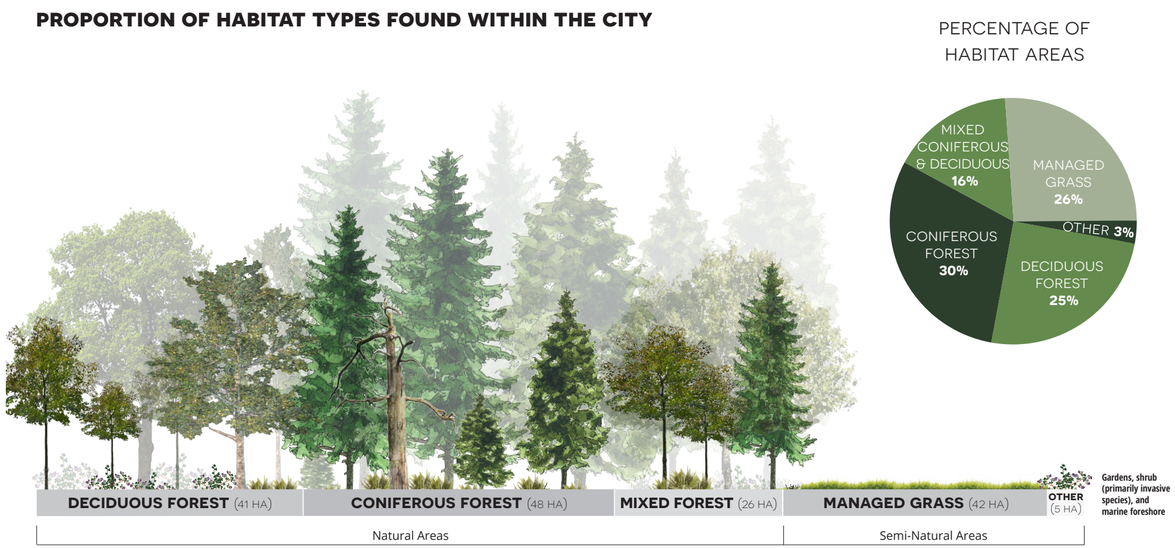


Figure 3. Habitat types found within the City.

Figure 4. Distribution of habitat types found within the City.

There are some large trees in the City including this Douglas-fir tree in Wagg Creek Park.

There is no remaining old growth forest in the City. All forested areas are second or third growth stands that are considered relatively young compared to the lifespan of a forest. The proportion of forest age classes found in the City are illustrated in Figure 5. Most forests are less than 80 years old and considered to be young relative to the lifespan of a coastal forest. The youngest are considered to be pole sapling stands and tend to be dense and uniform. These young and pole sapling forests have dense canopies limiting the growth of understory vegetation. As forests age the structure of the forest canopy becomes more diverse as the canopy opens up and new trees start to establish. The stands that are over 80 years old are considered mature and are starting to exhibit some of the characteristics that support high levels of biodiversity. These include a mix of tree species and sizes, large standing dead trees, woody debris on the forest floor and dense thickets of ground vegetation. Some of the oldest trees in the City are now a significant size, reaching heights of up to 55 m and diameters of over 1 m. The value of forests to support high levels of biodiversity generally increases with their age. The distribution of these forest stands is mapped in Figure 6.

PROPORTION OF FOREST AGES FOUND WITHIN THE CITY

Figure 5. Forest ages within the City.

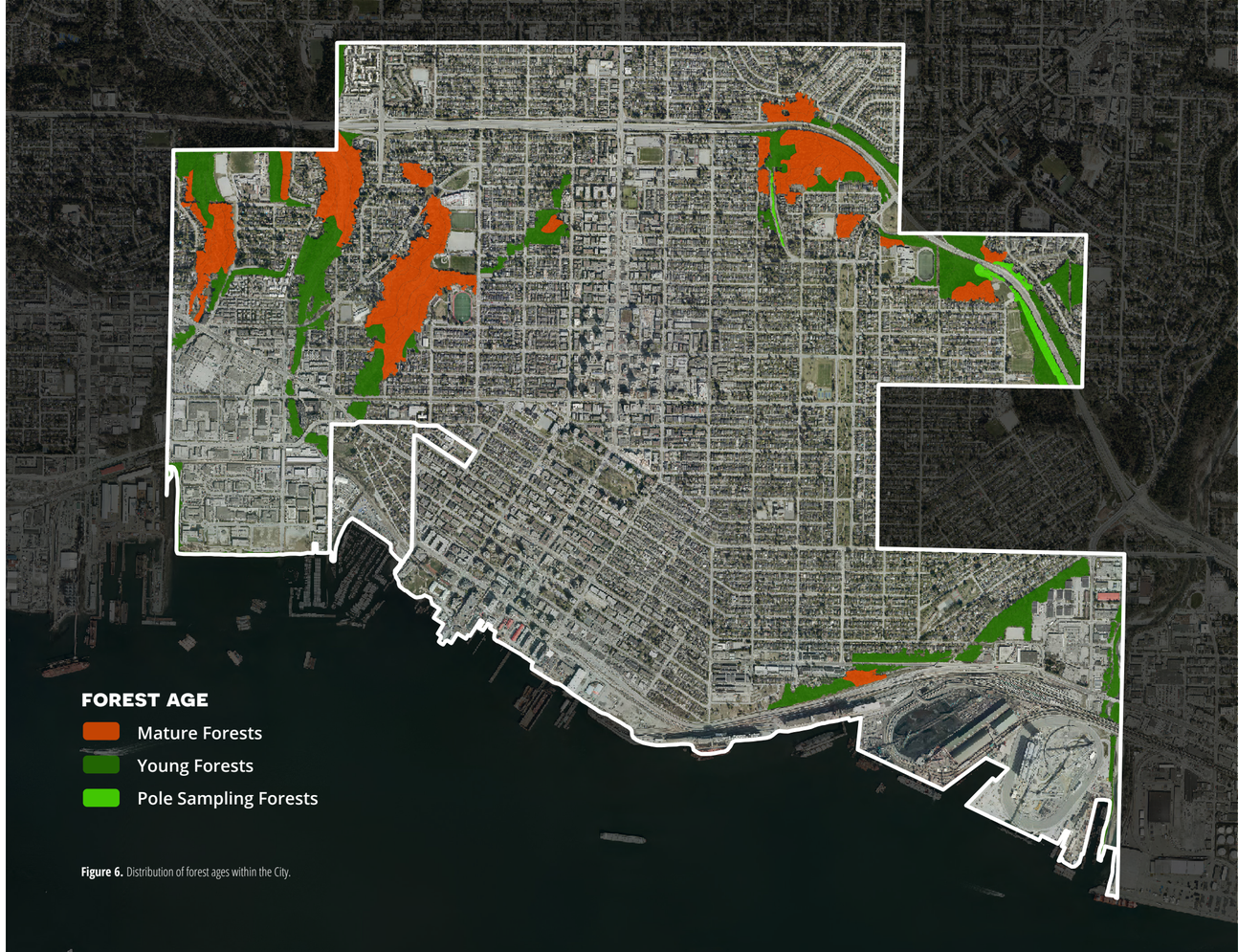


Figure 6. Distribution of forest ages within the City.

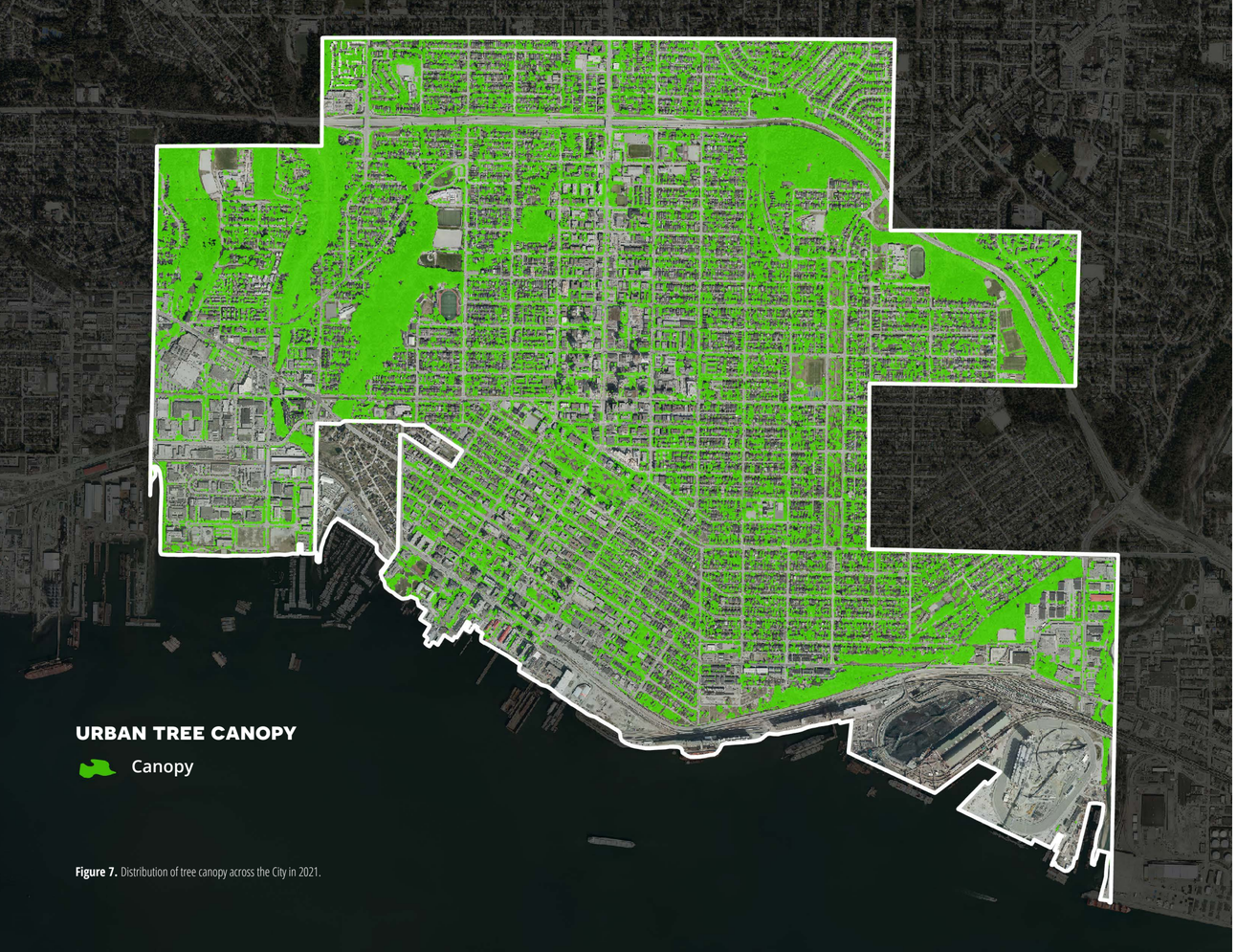


Figure 7. Distribution of tree canopy across the City in 2021.

Tree Canopy Cover

Trees provide the framework for natural ecosystems in the region. The temperate rainforest climate in the lower mainland is highly productive and trees will grow wherever there is soil and space for them. The amount of tree cover across the City is a good indicator of the amount of wildlife habitat that exists. While the habitat inventory provides a summary of natural and semi-natural ecosystems, canopy cover helps to understand the urban habitat that exists in urbanized parts of the City. LiDAR and orthophotos from 2021 were analysed and it was found that tree canopies cover 20% of the City (Figure 7).

Aerial image of lower Mackay Creek illustrating how canopy cover is calculated using LiDAR.

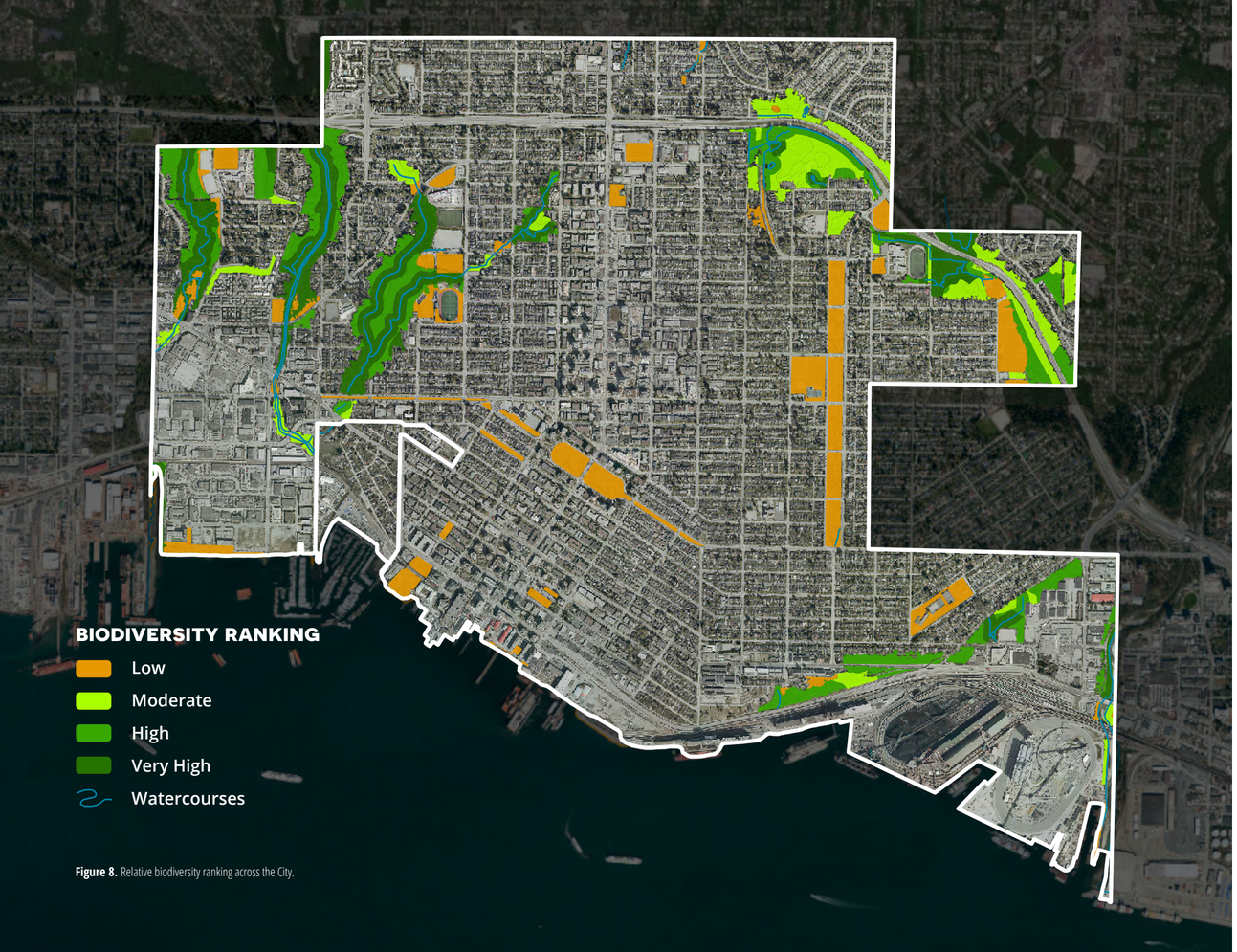


Figure 8. Relative biodiversity ranking across the City.

Measuring Relative Biodiversity

The level of biodiversity that a natural area can support is difficult to measure because it is affected by many complex and dynamic factors. In general, areas that support high levels of biodiversity include those that are large in size, connected to other natural areas, and provide a variety of habitat features including cover habitat, forage, and water. Measuring the exact number of species that inhabit an area is also difficult as the vast majority of them are small such as insects and microbiota. To gain an understanding of the relative value of biodiversity across the City, a list of higher order wildlife was analysed. This list includes 221 species of mammals, fish, birds, and amphibians (Appendix 3). It is assumed that the presence of these species is an indicator for the numerous species lower on the same food chain. Each natural habitat type was ranked out of 100 relative to each other based on the number of these species that would be expected to inhabit them.

To gain an understanding of the relative value of biodiversity across the City, a list of 221 species of mammals, fish, birds, and amphibians was analysed.

To account for the influences of urban development, modifiers were applied to this base ranking within each habitat polygon. Patches of habitat that are closely connected were grouped to calculate their collective size. The ranking of these areas was then modified to reflect the size and fragmentation of each patch area.

The interface zone that links aquatic and terrestrial ecosystems is known as riparian habitat. These areas are known to support higher levels of biodiversity than their counterparts. The scale of this influence depends on the type of terrestrial and aquatic habitats provided. Riparian areas within each habitat type were identified and multiplied by a modifier to reflect their positive influence on biodiversity.

Common yellowthroat warbler.

Areas within the urban interface are often disturbed in ways that reduce their capacity to support wildlife. These disturbances include encroachment from development, dumping, and infestations of non-native species. Each polygon was modified to reflect its level of disturbance. A more detailed description of this methodology is provided in Appendix 3.

The final biodiversity ranking provides a relative measure of which areas in the City support the greatest diversity of species (Figure 8). The highest-rated areas are generally larger in size, provide access to forage, protective cover, and water, and are least impacted by urban disturbances. These include the riparian corridors associated with MacKay, Mosquito, Mission and Wagg Creek. Two other areas rated as high include the wetland, stream complexes at the northwest corner of Greenwood Park and the north end of Loutet Park. The natural areas surrounding Keith Creek to the north of the highway also provide very high levels of biodiversity.

Aerial view of the City.

6.0 THREATS TO BIODIVERSITY

There are numerous existing and emerging threats to biodiversity. Urban development introduces permanent changes to the natural landscape. Certain species can adapt to these changes and live with us, while others are less tolerant. Climate change is modifying the habitat conditions that various lifeforms rely on making survival more difficult for some species. These climate changes are also improving the ability of other species to thrive, allowing some invasive species to spread easily and pest and disease outbreaks to become more extreme.

The threats to biodiversity have the greatest impacts to natural areas that interface with the urbanized landscape. Larger natural areas and those that are located in the interior of natural areas will generally be more resilient against these threats. Narrow stream corridors that extend through urbanized areas are particularly at risk such as the Wagg Creek corridor and the lower reaches of Mackay, Mahon and Mosquito Creeks.

The Impacts of Urban Growth

During the years that followed the City's incorporation in 1907, aggressive development began. In its early years of growth, the City was dubbed "The Ambitious City" as it developed a distinctly urban character. The City now supports a vibrant mix of commercial, institutional, and residential high density uses as well as lower density areas consisting of housing types such as stacked or terraced apartments, attached duplexes/triplexes, and single-family detached homes. The majority of public parks are located in these lower-density neighbourhoods, typically along stream routes which are often associated with environmentally sensitive areas.

Much of the City's land has already been developed, resulting in a slower growth rate than other municipalities in the Metro Vancouver region. Redevelopment has enabled a growth rate of approximately 1.3 per year which is expected to continue through 2031, consistent with the Regional Growth Strategy projections.

The densification of the City will continue to increase the pressure on biodiversity by permanently replacing lands currently occupied by trees, ground vegetation and impervious surfaces. Encroachment of development

also has the potential to destabilize slopes, increase pollution into streams, and introduce invasive species to natural areas. While the population increases, so does the impact of recreation on natural areas.

The densification of development on properties can have a larger ecological footprint causing the loss of natural features. It can however also be planned to concentrate the development to specific areas, allowing the rest of the property to be available for nature-scaping. The impacts of densification can be further mitigated by educating homeowners on the benefits of naturalizing their properties. On City land, increasing canopy cover and creating linear habitat corridors along streetscapes can help connect fragmented habitats.

The Impacts of Climate change

Climate change is altering the growing conditions for plants and trees across the province. Modelling is predicting that the climate in North Vancouver will shift to be warmer with longer periods of drought. The average temperature is predicted to increase by 3 degrees by 2050 and the number of days over 25 degrees is expected to double from 22 to 55. Annual precipitation is expected to increase, however not evenly throughout the year. The amount of rain that falls over the course of the year is expected to increase, however the summer drought will be exacerbated by a 30% decrease in rainfall between May and September. In 2021 and 2022, the Metro Vancouver region has experienced record breaking droughts. The drought that started in the summer of 2022 extended into the middle of October and reached the highest level of drought severity class.

This shift in climate conditions will have significant impacts on the survival and composition of our forests and the species that live there. The plant communities that are growing today will adapt over time, and species less tolerant of drier and hotter summer conditions will become less prevalent while species that are better adapted will thrive.

Drought conditions impact the availability of water for wildlife and plants. Some wildlife cannot travel easily and will not survive. Wildlife that can travel, must go further distances to find water. This can concentrate species into smaller areas increasing competition and the potential for predation. Plants and trees must survive with the water that is available within their rooting zone. Many become so depleted that they will die or become severely stressed making them susceptible to pests and diseases.

The average temperature is predicted to increase by 3 degrees by 2050 and the number of days over 25 degrees is expected to double from 22 to 55.

In rivers, a lack of water input through the late summer and fall can have detrimental impacts on fish populations. Low river levels on the coast in the fall of 2022 caused the death of large numbers of migrating salmon. Resident species can become trapped in isolated pools with low food resources and poor water quality.

Changes in weather patterns affect the timing of life cycles including migration, the blooming of flowers and reproduction. The habitat range of species can increase or decrease. This shift can cause the spread of pest and diseases into areas that they could not survive previously. The dynamic of species throughout the food chain and the effects that the changing climate will have is complex and difficult to predict. It is expected that there will be some species that will not survive. The IPCC estimates that 20-30% of the plant and animal species evaluated so far in climate change studies are at risk of extinction if temperatures reach the levels projected to occur by the end of this century.

Western redcedars are showing signs of stress from the effects of recent prolonged summer droughts from 2021 and 2022. The plight of this moisture-loving species is visible across the city by the reddening of their leaves, a stress response to a lack of water availability. On the driest sites, many cedar trees have already died.

Aerial view of dead trees in Kealy Woody Park

The City is taking steps to try and mitigate the impacts of the hemlock looper. This stem was wrapped in a sticky band to try and prevent grubs from crawling up to the crown of the tree.

In 2019, an outbreak of the western hemlock looper moth began across the North Shore. The larvae of this moth feeds aggressively on the needles of western hemlocks and Douglas-fir, resulting in large patches of brown, sickly-looking trees. As western hemlocks are already prone to heat stress, the defoliation from these insects places these trees under even greater pressure during periods of summer drought. Large areas of defoliated hemlocks and Douglas-fir trees are visible in many City parks. Many of the trees impacted by the hemlock looper moth are the largest conifers in the City. A large component of the hemlock population has been impacted and there are areas such as Mahon Park where many of the mature Douglas-fir have also been affected.

Climate change projections indicate that these two iconic species of west coast forests, the western redcedar and western hemlock, will become less abundant in our regions' forests in the future. Preventing this decline is challenging as it requires that water be provided to these trees during times of extreme heat and drought. Water restrictions during these periods and logistics make this difficult. Over time, trees and plants that are less tolerant of our changing climate will decline and more drought-tolerant species will take their place. We can help forest ecosystems and plant communities to make this adaptation sooner by planting trees and shrubs that we know will thrive under the future growing conditions. Sourcing plants and seeds from populations adapted to drier climates will introduce drought-tolerant genetics to our region. For example, sword fern (Polystichum munitum) grows naturally as far south as Baja, California. Southern populations of this species are adapted to the drier climate and can tolerate drought better than their northern counterparts.

Appendix 1 provides a table with a summary of recommended native trees, shrubs, ferns and herbs that should be considered when restoring natural areas in the City.

Aerial view of dead and dying trees in Mahon Park that have been impacted by the hemlock looper.

Figure 9. Location of inventoried invasive plants from 2020 within the City.

The Impact of Invasive Plants and Animals

Invasive plants and animals have been identified as one of the greatest threats to biodiversity. These species are aggressive and outcompete our native species. These infestations can be very impactful in smaller, less resilient natural areas like urban parks. The primary methods of transport of these invasive plant species are by birds, water or wind, spread from adjacent landscapes/gardens, and spread from dumped green waste. These invaders continue to be a serious threat to the integrity of ecosystems in the City.

The City has been aggressively managing invasive plants since 2011. They have been carrying out detailed inventories across the City to understand the extent of these infestations and to monitor how effective annual treatments have been working. This invasive species strategy includes targeted treatment in highly sensitive areas and for the species that pose the greatest threat to biodiversity.

The updated invasive plant inventory completed in 2020 showed a major reduction in abundance and distribution of two high-risk species, giant hogweed (94% reduction in impacted area) and knotweed species (86% reduction in impacted area) after an eight-year, City-wide treatment program. Over 1,500 historic invasive species, occurrences showed no presence during the survey, indicating successful removal as a part of City and community restoration efforts. No new provincially listed noxious weed species, Early Detection and Rapid Response (EDRR) species (provincially or regionally recognized) or emergent species of major concern were found. However, there was still an overall increase in the abundance and distribution of all invasive plant species (except knotweed and giant hogweed), even with ongoing restoration efforts (Figure 9).

Himalayan knotweed.

7.0

Great horned owl.

RECOMMENDATIONS

The City's urbanized areas, natural parks, and passive parks are well established. There are opportunities to restore and enhance these areas to support a greater diversity of species. This includes the natural environment as well as features that can be incorporated into the urbanized landscape and on built structures. Recommended actions to enhance biodiversity are organized by themes to protect and enhance natural areas, connect these areas together, educate citizens and to monitor the state of biodiversity over time. The following are 12 high-level goals that have been adopted to direct these recommendations. These have been developed to be consistent with and support the draft Climate and Environment Strategy.

GOAL 1 *Protect natural area parks in the City from the impacts of adjacent development and recreational activities*

GOAL 2 *Restore areas in natural areas parks that have been degraded*

GOAL 3 *Protect water quality in freshwater streams and enhance the habitat they provide for fish populations*

GOAL 4 *Encourage wildlife movement across the City by acquiring and restoring corridors identified in the Natural Habitat Network*

GOAL 5 *Increase the diversity and cover of trees, ground vegetation and habitat features in urban parks*

GOAL 6 *Design and enhance greenways to include continuous cover of tree canopy and ground vegetation*

GOAL 7 *Encourage residents to install trees and ground vegetation, water sources and nesting sites for wildlife*

GOAL 8 *Develop planning policy that will promote green buildings designed to minimize their impact on wildlife*

GOAL 9 *Naturalize the marine foreshore, where possible, through the installation of trees and vegetation and engineered habitat features*

GOAL 10 *Educate the public on the benefits of natural areas and encourage stewardship of natural areas, watercourses, and wildlife*

GOAL 11 *Monitor the state of natural elements that indicate the health of ecosystems and biodiversity to evaluate the effectiveness of the City's environmental policies*

GOAL 12 *Review and update City policy to improve the protection and enhancement of natural areas*

Planting of native shrubs and trees within a degraded area of Loutet Park.

Protect and enhance natural area parks

The City's natural parks support the majority of wildlife that inhabit the City. The integrity of these natural areas however, is being impacted by the changing climate. They are also being degraded by local factors such as development, illegal encroachment, the release of pollutants and the invasion of non-native species. Natural parks in the City are also heavily used for recreation. While recreation has positive impacts on the health and well-being of residents, it can be a detriment to the health of an ecosystem. Protecting the integrity of these remaining natural area parks is a priority for the City.

The City's natural areas and streams help to mitigate the impacts of heatwaves, air pollution, flooding, stormwater surges and provide access for residents to the natural world, improving their health and mental well-being.

In addition to supporting high levels of biodiversity, these natural areas provide additional benefits. These include climate mitigation through carbon sequestration and enhancing the City's resilience to the impacts of climate change. The City's natural areas and streams help to mitigate the impacts of heatwaves, air pollution, flooding and stormwater surges. These areas also provide access for residents to the natural world, improving their health and mental well-being.

To protect these natural areas, policy should be developed that regulates adjacent development. Natural and physical barriers should be installed to prevent encroachment. There are also opportunities to enhance the integrity of these natural areas providing habitat for a greater number of species. Recommended plants for restoration, pollinator gardens as well as plants considered culturally important are provided in Appendix 1.

Freshwater streams that run through the City provide water that is essential for life. These watercourses support healthy aquatic ecosystems of fish, amphibians, and invertebrates. Streams flow through the City connecting to the marine foreshore. The City's Integrated Stormwater Management Plan emphasizes that there is an improvement in stream health with the reduction of impervious surfaces in the watershed. Impervious surfaces and the design of the stormwater systems affect how a spill of deleterious substances could reach the City's streams. Wagg Creek was found to have the highest concentrations of metals and the lower levels of benthic invertebrates. It also has the most degraded and narrowest riparian setback areas. The protection and enhancement of these watercourses are critical for maintaining a healthy and diverse community of natural areas. Recommendations for protecting and enhancing natural area parks and the watercourses that run through them are summarized in Table 1.

Rainbow trout.

Kings Mill Walk Park.

Table 1. Recommendations to protect and enhance the integrity of natural areas in parks.

POLICY AND PLANNING – ADOPT POLICIES THAT DIRECT STAFF TO PROTECT NATURAL AREAS, ENFORCE BYLAWS AND EDUCATE THE PUBLIC.

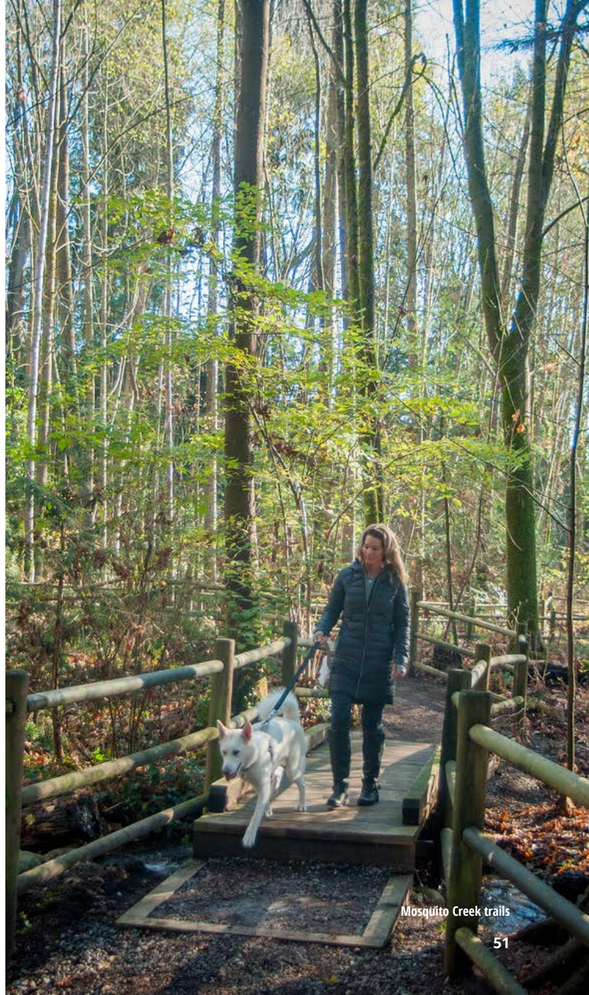
- Adopt a policy of no net loss of natural areas in parcels owned by the City.
- Increase the size of natural areas in parks. Identify and restore passive areas adjacent to natural forests that are underutilized and have potential for habitat restoration.
- Identify private property encroachment into parks.
- Develop educational signage to highlight known species at risk, impacts of dumping/invasive species and other ecological features in parks.

WILDLIFE – PROTECT WILDLIFE POPULATIONS BY PRESERVING AND ENHANCING THE HABITATS THEY RELY ON TO THRIVE.

- Designate wildlife refuge areas in parks. These areas should be fenced with educational signage, have a low density of trails, and not allow dogs off-leash.
- Protect and enhance identified critical habitat, and install habitat features for federally and provincially listed species at risk.
- Install bird nesting boxes in young forest types that have few natural wildlife trees.
- Install bat roosting boxes along south aspect exposures of natural forests.
- Install snake hibernacula in sunny locations adjacent to natural areas.
- Increase the number of open water sources for wildlife to access.
- Continue to enforce the protection of bird nests in accordance with the Wildlife Act, and Migratory Birds Convention Act. Best practices include requiring bird nest surveys by a QEP prior to removing trees. Residents should be encouraged to look for nests prior to removing vegetation, trimming hedges or pruning trees.

STREAMS – PROTECT, RESTORE, AND ENHANCE WATERCOURSES AND THEIR RIPARIAN SETBACKS SO THAT THEY PROVIDE BETTER HABITATS FOR PEOPLE AND WILDLIFE.

- Daylight culverted streams, prioritizing ones that would provide additional fish habitat and/or upstream fish access.
- Build new wetlands. These should ideally be located partly against natural plant communities. They can be designed to receive stormwater and act as natural filters to help prevent the pollution of natural streams.
- Restore degraded reaches of streams to provide cover, shade, and to stabilize banks. Install instream features to enhance habitat diversity such as logs and boulders.
- Remove barriers that are restricting fish migration along streams. Work with Metro Vancouver to improve the fish passability at the trunk sewer weir at 3rd street along Mosquito creek.
- Prevent the discharge of sediment and pollutants into natural streams.
- Avoid or mitigate changes to natural drainage patterns surrounding and within parks.
- Complete all work within a fish-bearing watercourse during the regional instream window.
- Focus construction activities adjacent to aquatic habitat during favourable weather and low water conditions.
- Minimize trail crossing of watercourses. Where necessary, install clear span bridges or open-bottomed stream crossings whenever feasible.
- Incorporate fish baffles to support fish passage through enclosed crossings.
- Continue to incorporate green infrastructure such as bioswales and rain gardens along roads and parking areas as part of stormwater management.



Mosquito Creek trails

Loutet forest.

FOREST COMMUNITIES - ESTABLISH DIVERSE NATIVE FOREST COMMUNITIES THAT NATURALLY ADAPT TO FUTURE CLIMATIC CONDITIONS.

- Protect natural forests from the impacts of climate change, pests and disease outbreaks. Professional foresters should monitor forest health on a regular basis and provide site specific recommendations to mitigate against abiotic agents such as drought, wind and heat as well as strategies to prevent unnatural pest and disease outbreaks.
- Increase plant and tree species diversity in natural areas, focusing on the youngest forest with low species diversity.
- Plant trees and vegetation that are naturally adapted to our future climatic conditions (different species as well as genetically adapted stock).
- Protect wildlife trees. Adopt a tree risk policy that recognizes the value of dead and dying trees in natural areas.
- When removing trees, leave the large woody stems on the ground as habitat elements and nurse logs.
- Implement biodiversity thinning to create canopy openings and wildlife trees in young forests with low structural diversity.
- Continue to create wildlife trees from trees that would otherwise be removed for risk mitigation.
- Continue to aggressively manage invasive plants and animals in the City.

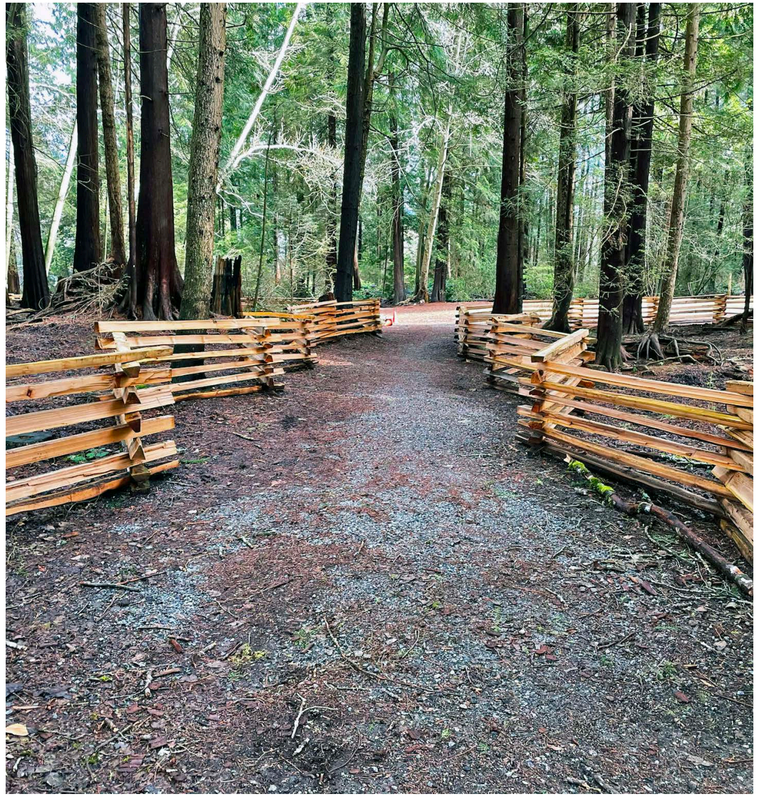
RECREATION - PROMOTE RESPONSIBLE RECREATION IN NATURAL AREAS BY LOCATING TRAILS AND CREATING BARRIERS TO AVOID SENSITIVE HABITATS SUCH AS STREAMS, WETLANDS, AND RIPARIAN AREAS.

- Restore non-sanctioned trails to a natural state.
- Fence off sensitive habitat areas such as wetlands and riparian areas to limit human and dog access.
- Relocate trails that are within 5 m of a watercourse or install fencing to separate users and dogs from access to the watercourse.
- Install fencing along trails that are within 10 m of stream crossings. Where fencing is not ideal, planting of native thorny shrub communities can create a natural barrier.
- Relocate illegal encampments (eg. work with appropriate support programs) and remove refuse.

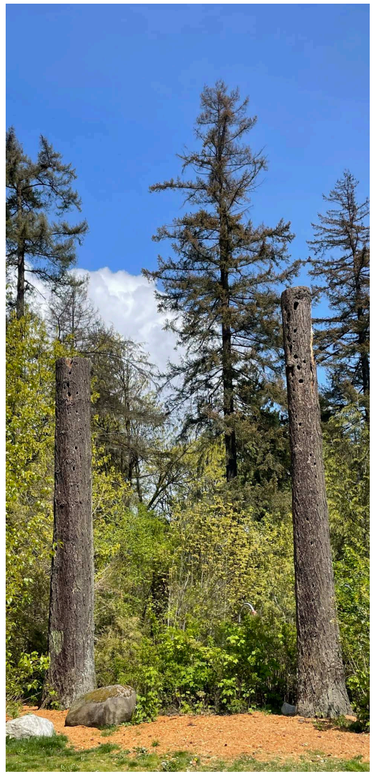
South facing passive park area in Mahon Park between the Pickleball courts and water park. This area is suitable to plant a climate adapted plant community.

Increasing natural areas in parks

The majority of natural areas in the City are within protected parkland. There are opportunities to increase the amount of natural area in the City by restoring fringe areas along with natural area forests that are infrequently used for passive recreation. This includes many of the turf grass areas adjacent to forests. Restoring these edges allows for the introduction of shrubs and trees not commonly found in these natural areas, including climate adaptable species. Many of these species prefer drier and sunnier conditions and will establish better along the southern and western facing open edges of forests. Once established, these species will act as a seed bank and spread into the adjacent natural areas over time.



Fencing within Eastview Park restricts access to degraded forest areas being restored.



The lower stems of dead trees were left in Mahon Park near Fen Burdett Stadium which now provide high value habitat for birds and bats.

Bat boxes being installed in a young forest in Eagle Creek Ravine in Burnaby.

Bats

Bats are highly complex and unique mammals. They are nocturnal, use echolocation to navigate, and are one of nature's best mosquito predators – eating up to their body weight every night! Though bats are critical components of our ecosystems, their populations are threatened. Half of the sixteen bat species in BC are listed as vulnerable or threatened, in large part due to White-nose Syndrome, an invasive fungus that infects hibernating bats. Loss of habitat is the next most pressing driver of this animal's decline. Urbanization and the simplification of naturally forested areas leaves bats without critical structures for roosting, such as loose bark on standing dead trees.

To help support bat populations in our City, consider installing a bat box in your yard to provide these creatures with some much-needed roosting habitat. Properties with lots of open space, within 400 m of a water source, and with a southward exposure are priority areas to consider for installing bat boxes.

Townsend's big-eared bat.

A young forest with low structural diversity and little understory vegetation in Eastview Park.

Biodiversity Thinning

The natural park areas in the City consist of second-growth forests that are relatively young within the typical lifespan of a coastal forest. Many of these forests lack structural complexity and support lower plant and trees species diversity. The forests are relatively dense and uniform restricting light from reaching the forest floor. This restricts the species that can establish in the understory for the canopy to those that are adapted to low light conditions. As forests age and the canopy opens up, more light penetrates the ground, and the diversity of plants and trees increases. The health of understory shrubs and trees also improves, creating a denser cover for the protection of small wildlife. Eventually, as forests reach a mature to old-growth state, they provide habitat elements such as large dead standing trees that are used by birds and small mammals, as well as large woody debris on the ground which is used as cover for ground species.

Biodiversity thinning is a technique used to increase this natural successional process. Small canopy gaps are created by girdling and/or felling a group of trees. Trees that are girdled will die in place and over time develop into high-value wildlife trees. As the trees die, an opening will form in the canopy allowing light to reach the forest floor which encourages ground vegetation to establish. A younger generation of trees will grow into this space, creating structural diversity in the canopy. The areas targeted for this treatment must be away from trails and urban interface areas so that these trees will not pose a risk when they eventually fall.

Protecting species-at-risk in North Vancouver

Natural areas in the City of North Vancouver provide a home for some of British Columbia's at-risk species. Forests, streams, and the marine foreshore all provide valuable habitat within the heavily urbanized surrounding environment. Red listed species at risk are those that are extricated, endangered or threated in BC. The red listed species that have been confirmed living in the City include the Western Grebe and the Pacific Water Shrew. There are other red listed species that may live within the natural areas of the City but have not yet been recorded. Some of these include Townsend's Mole, Long -tailed Weasel, Southern Red-backed Vole, Peregrine Falcon, Barn Owl and Black-crowned Night Hawk. The Barn Owl and Peregrine Falcon have managed to adapt to and inhabit urban landscapes. Most other species at risk require natural areas that are less common in cities. Habitats that tend to support species at risk include wetlands, intertidal area, streams, and adjacent riparian areas.

The City can support species at risk in the City by protecting their largest natural parks that are associated with water and provide refuge from urbanized areas. These areas could be designated as wildlife refuge areas. They would be fenced with limited access for passive recreation only and would not allow dogs off leash. These areas can be showcased with wildlife viewing platforms and educational signage. Potential areas to consider for designation as wildlife refuge areas are illustrated in Figure 10.

TOP: Western grebes feeding their babies. BOTTOM: Townsend's mole.

Figure 10. The natural habitat network.

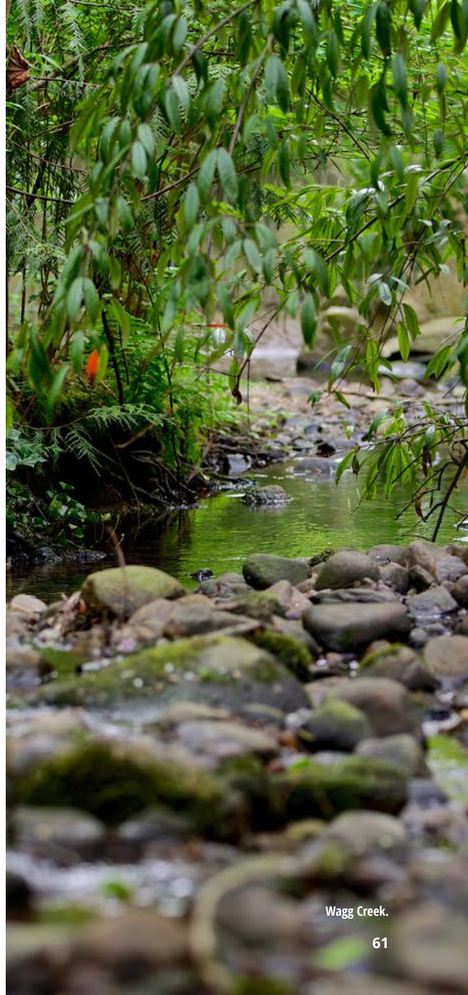
Connect protected natural areas through a Natural Habitat Network

The Natural Habitat Network (NHN) includes the significant natural areas that support the highest level of biodiversity within the City, as well as connecting corridors that facilitate the movement of species between these areas (Figure 11). This network allows migration of species, healthy interpopulation breeding, and provides access to different habitats to support their life requirements.

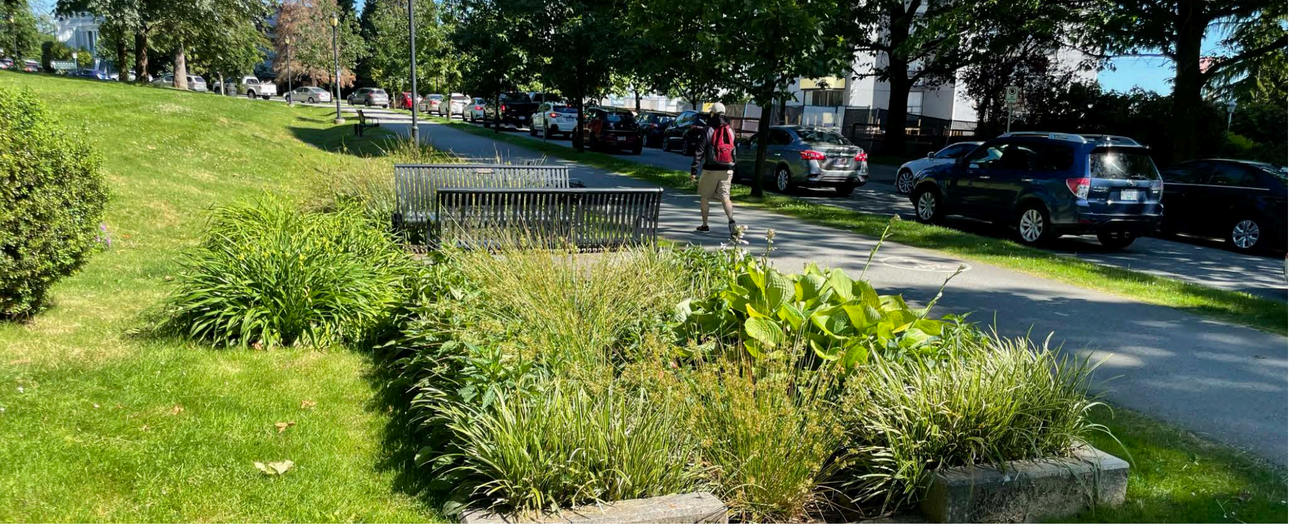
The larger habitat areas are identified as habitat hubs. These include natural areas that are less disturbed and/or less influenced by the adjacent urban areas. They tend to be large enough to include some interior habitat, providing species with a refuge area from urban noise and light. This is particularly important for species that are less tolerant of human activity. Smaller parks that aren't large enough to provide these interior habitat areas are still important and are identified as habitat sites.

The populations of wildlife that inhabit these hubs and sites need to be able to safely move between them. This is important to provide a better range of habitat types and promote interbreeding of populations. Most of the natural areas in the City are characterized by linear watercourses that flow from the North Shore mountains to the ocean. These streams and their riparian setbacks provide valuable travel corridors for wildlife. These are identified as natural corridors as part of the network. Other natural areas that provide travel corridors include narrow natural areas such as those along right of ways adjacent to the highway, linear park areas such as Moodyville, High Place, and Sunrise Parks. The wider these corridors are the more functional they are to provide safe travel for the species that travel across the City.

The City also aims to facilitate the movement of some wildlife through urbanized areas. Urban corridors have been identified that aim to support the movement of flying species including birds and pollinating insects. These corridors are generally constrained in width as they follow urban parks and pathways designed for pedestrian travel. These corridors will be enhanced to better support wildlife movement through the planting of trees, hedgerows, and flowers for pollinators.



Wagg Creek.



A bioswale provides a small but valuable habitat areas and water source in Victoria Park along the Natural Habitat Network.

Table 2. Recommendations to connect natural areas in the City.

PLANNING/POLICY - ADOPT THE NATURAL HABITAT NETWORK AND PRIORITIZE THE PROTECTION, ENHANCEMENT AND ACQUISITION OF ITS IDENTIFIED CORE HABITAT AREAS AND MOVEMENT CORRIDORS.
• Recognize and adopt the Natural Habitat Network (NHN) for protection and enhancement within the OCP and other strategic plans and policies. • Adopt an Environmentally Sensitive Area Development Permit Area that protects the NHN from adjacent development impacts. • Acquire and naturalize new parkland in and adjacent to the NHN. Areas should be prioritized that improve the connectivity between large natural areas. Priority areas should include lands that would expand the natural areas along Wagg Creek. Secondary priorities should include lands that improve the connections between Mosquito, Mahon and Mackay Parks. • Explore financial tools to fund the long term acquisition of lands to enhance the NHN. • Adopt and enforce traffic calming measures at road crossings along Urban and Natural Corridors. • Install landscaped bump outs where corridors cross streets.

The Queen Mary community garden provides valuable habitat for wildlife along the Natural Habitat Network.

Figure 11. The City's Natural Habitat Network.

Pollinator gardens

Pollinator species include many animals and insects such as bees, butterflies and moths, birds and bats, and beetles. They perform critical roles in our ecosystems, transferring pollen from plant to plant ensuring their reproduction and the production of fruits. The presence of a healthy pollinator community is a good indicator of the health of an ecosystem.

In the urban matrix, plant communities are often fragmented and spread apart from each other. This can make it difficult for pollinators to find the plants they are looking for to pollinate. Planting pollinator gardens in strategic locations across the City can support these species and the important role that they play in our ecosystems.

The City has large green spaces throughout its urbanized neighbourhoods that are designated for public use. There are opportunities to transform areas currently covered with turf grass into pollinator gardens. In more urbanized areas where space is limited, planter boxes and hanging planter baskets can provide a source of nectar for pollinators. To support these designated gardens, pollinator-friendly practices should be adopted such as restrictions on mowing and the use of chemicals. Signage should be installed to inform locals of the benefits of pollinator gardens and how they can contribute as stewards of these areas.

A pollinator garden installed along Grand Boulevard.

While pollinators need access to nectar to survive, they also require a suitable place to nest near their food sources. Some species, such as mason bees, rarely stray farther than 100 m from their nesting site. Other migrating species fly far distances to multiple sites to find their food. A variety of features ranging from rock piles, organic debris, abandoned nests and human-made structures can provide the year-round habitat necessary for these species to thrive. The incorporation of shelter and protection should be included when planning pollinator gardens.

In the urban matrix, plant communities are often fragmented and spread apart from each other. This can make it difficult for pollinators to find the plants they are looking for to pollinate.

When located within parks, planters, boulevards and medians, pollinator gardens can support green corridors that connect larger green spaces across the city. The pollinators that inhabit these areas are a food source for other wildlife higher in the food chain. They also provide habitat for other species that need materials and places to build their nests, whether bare soil, wood, resin, or plant parts.

Providing pollinators with ample food and habitat opportunities supports biodiversity within and beyond the garden. Invertebrate pollinators play a key role in the food web as they convert and transfer plant energy. Creating pollinator gardens should focus on native plant species that are known to produce ample pollen. Professor Douglas Tallamy, author of the research article “A Call for Backyard Biodiversity” published in American Forests Magazine states that choosing native plants which have long evolutionary relationships with local wildlife will support almost 30 times more species than ornamental plants. It is also important to provide plants that flower throughout the seasons, from early spring to late fall, to provide a consistent food source and pace when flowers are in bloom. A list of recommended pollinator species to plant in gardens is provided in Appendix 1.

Monarch butterfly.

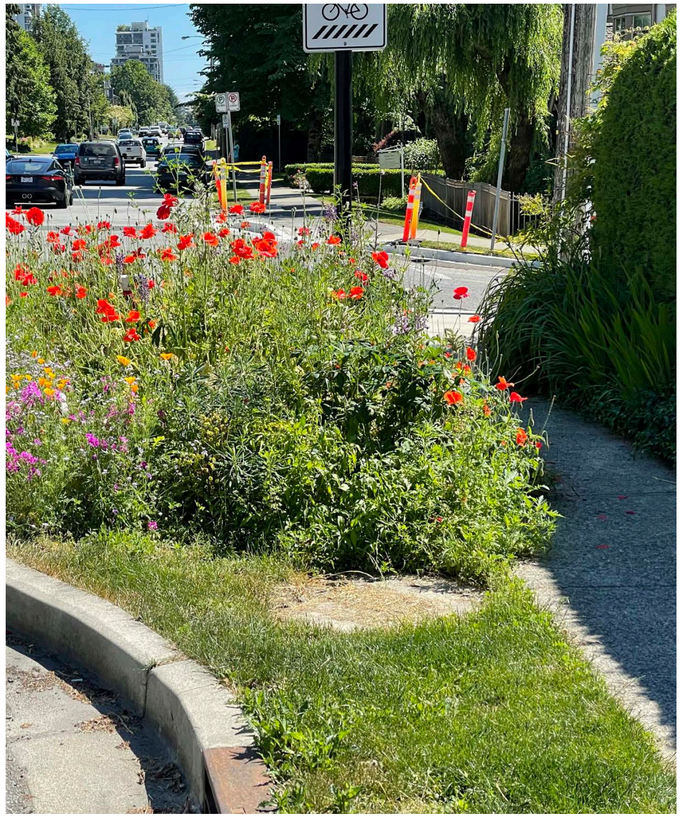
There are opportunities in passive park areas such as Grand Boulevard to increase habitat for wildlife.

Enhance Habitat within Urban Parks

Many urban parks in the City are dominated by turf grass with scattered individual trees or small groupings of trees and landscaped areas. They are generally characterized by features that are meant to facilitate recreational use rather than provide habitat for wildlife. These parks can be enhanced to encourage wildlife to travel through and make use of them. Habitat elements that are often missing from these areas include those that provide protective cover, food, and water. Turf grass and areas that do not provide high recreation values could be converted to plant communities of trees, shrubs, and pollinators. Ideally, these pockets of habitat should be close together or connect to promote the movement of birds, small mammals and insects. Other features that would support wildlife include logs and boulders, nesting boxes and water features.

Table 3. Recommendations to enhance habitat within urban parks.

PLANNING/POLICY - UTILIZE NATURAL METHODS FOR PEST CONTROL
• Minimize the use of herbicides and pesticides on private and public lands.
WILDLIFE - INSTALL HUMAN-MADE AND NATURAL HABITAT FEATURES TO ENCOURAGE WILDLIFE TO INHABIT URBAN PARKS
• Increase the cover of trees and ground vegetation in parks and along the Natural Habitat Network to provide continuous cover for wildlife movement. • Install pollinator gardens and housing structures for pollinators at regular intervals along the Urban Corridors. • Install habitat features for wildlife along Natural Corridors, including bird nesting boxes, bat roosting boxes and raptors perches. • Install water features along Urban and Natural Corridors including daylighted steams, ponds, wetlands, and rain gardens. • Install large woody debris in landscaped areas along Urban and Natural Corridors.
TREES AND VEGETATION - PLANT AND PROTECT A DIVERSITY OF NATIVE TREES AND SHRUBS
• Reduce the frequency of mowing to allow select fields to establish as meadows, providing pollinator habitat and cover for small mammals and wildlife. • Plant trees with a target of establishing >50% tree cover within each urban park. • Plant a diversity of tree and shrub species that are adapted to the changing climate. This would ideally include trees that will grow large in size and have long lifespans. • Protect large trees with landscaped buffers around their trunks. • Recycle leaves from turf areas to biodegrade in planting beds. • Encourage and establish pollinator gardens through community gardens and in urban parks.



A boulevard bump out planter with pollinator species near Wagg Creek Park.

Enhance habitat along streetscapes

Streets serve to move people through neighbourhoods by vehicle, on foot or by human-powered means such as bikes and skateboards. They are often narrow and dominated by pavement limiting the available above-ground and below-ground space for trees and plants to grow. There are opportunities to improve the design of these linear features to help support the safe travel of wildlife across the urbanized landscapes. This includes the planting of street trees along with the installation of engineered structures for tree root growth. Boulevards can be planted with linear hedgerows or small pollinator gardens. Maintenance of vegetation along streets can be greatly enhanced by the stewardship of nearby residents.

The City has been installing bioswales whenever possible along roadways and sidewalks to capture stormwater and promote the natural infiltration and cleaning of this water. This helps buffer the volume and speed of water entering streams during storm events. Large volumes of water can overfill a stream and carry large amounts of energy, increasing the erosion of its banks. Slowing down the speed of water and encouraging slow filtration naturally helps to clean pollutants and sediments that are carried from our streets and allows groundwater to recharge.

Lower Lonsdale on 1st Avenue.

Table 4. Recommendations to enhance habitat along streetscapes.

PLANNING - IMPROVE THE DESIGN OF STREETS ALONG THE NATURAL HABITAT NETWORK TO ENCOURAGE TRAVEL BY WILDLIFE.
• Direct street lighting to minimize light pollution. • Install landscaped bump outs where corridors cross streets.
TREES AND VEGETATION - INCREASE THE NUMBER OF TREES AND GROUND VEGETATION ALONG STREETS AND BOULEVARDS.
• Plant trees so that they provide a continuous canopy cover along Urban Corridors. • Provide sufficient soil volumes to support trees that can grow large and for a long time. • Install soil volume cells where necessary to support tree growth and water absorption. • Plant ground vegetation in pockets or linear hedgerows along boulevard areas.

Bioswale on Londsdale captures stormwater from the road and sidewalk.

Enhance habitat in the City's residential neighbourhoods

The City has well-established residential neighbourhoods which include fragmented habitat elements of trees, landscaping, and gardens. These urban areas provide habitat best suited to species that can fly or are adapted to use small areas. When designing residential homes, natural elements can be included that will maximize the habitat value for wildlife and reduce the impacts to them. Naturescaping is a term used to describe gardening that focuses on native plants and trees and provides habitat to support wildlife such as water sources, bird, bat and pollinator homes. The installation and maintenance of these habitat features are dependent on the commitment and stewardship of the property owner. The City can encourage habitat enhancement on private property by providing incentives and educational materials.

Black capped chickadees are common visitors to backyards.

Table 5. Recommendations to enhance habitat in residential neighbourhoods.

LANDSCAPING - ENCOURAGE NATURE-SCAPING AND THE CREATION OF HABITAT FEATURES AND NON-TREATED WATER SOURCES
• Educate developers and residents on the benefits of nature-scaping as well as the impacts of invasive species and dumping of yard waste into green spaces. • Encourage a target tree cover per lot of >30%. • Encourage a target of pervious surface cover of 50% of each lot excluding the building footprint. • Encourage rainwater capture and reuse for irrigation of landscaped areas. • Provide recommended native vegetation species to incorporate into landscape design. • Educate residents on invasive plant species and the best methods for their removal and disposal. • Discourage the use of industrial fertilizers and herbicides in landscaping operations. • Retain organic materials such as leaves and cuttings as mulch or in piles. • Encourage residents not to rake their leaves to fertilize soils and provides habitat for insects and pollinators.
STRUCTURES - ENCOURAGE RESIDENTS TO IMPROVE HABITAT FOR BIRDS
• Provide water sources such as birdbaths. • Install light reduction techniques such as directing light away from natural areas, and reducing spill lighting. • Encourage residents to install anti-collision products on windows and to keep plants away from windows. • Educate cat owners on the impacts of cat predation and options for reducing those impacts.

An example of a yard that has been converted to a pollinator garden featuring lavender, cone flowers, yarrow, phlox, mint and hyssop.

Converting lawns

In 17th century England, manicured lawns were a display of exorbitant wealth and only the rich could afford to own and maintain vast swaths of purely decorative land. Centuries later, this concept is still visible across North America where lawns are the default landscape of most modern homes. But what if this old tradition was reimagined for the present day? Instead of covering our neighbourhoods with a monoculture of non-native grass that require large amounts of water, gasoline, and fertilizer to maintain, what if we created greenspaces that provide benefits for us, wildlife, and the planet?

Re-naturalizing a lawn can be easy. Simple actions like letting your lawn grow tall in the spring can create habitat and forage for insects and pollinators during this important time in their lifecycle. In the fall, leave leaves unraked to provide cover for birds, mammals, and insects. Leaves are also a great source of fertilizer that help replenish your yard's ecosystem without the added costs of industrial fertilizers.

Re-naturalizing a lawn can be easy. Simple actions like letting your lawn grow tall in the spring can create habitat and forage for insects and pollinators during this important time in their lifecycle.

To improve wildlife habitat further, plant native species like shrubs and wildflowers. Native species have evolved with the climate and ecosystems of our region, so they need fewer added inputs like water and fertilizer to survive while also contributing to the local food chain. These plants help dwindling pollinator species regain habitat throughout the urban matrix, which helps to attract birds and improve the biodiversity of our City. Fallen twigs and branches provide nesting material for birds and food for insects, too. Where possible, creating a garden with a mix of trees, shrubs, ferns, and herbs will provide the most habitat for local species, with added benefits like shade, food, and a nice view.

The impacts of cats on wild bird populations

Cats are aggressive predators that instinctively kill the birds, small mammals, and amphibians we are trying to protect. Their opportunistic hunting behaviour means birds frequenting feeders and species that nest or forage on or near the ground tend to be more at risk. A research paper published by the Avian Conservation and Ecology found that urban pet cats contribute to one-sixth of the deaths of birds in Canada – an estimated 105 to 348 million per year (Blancher, 2013) . With over one-third of households in Canada estimated to have pet cats, certain measures can be taken to help protect urban bird populations.

The Stewardship Centre for BC (SCBC) has begun a Cats and Birds program, which is supported and funded by Environment and Climate Change Canada, to better understand the relationship between these furry pets and wild birds. With the support of Birds Canada, the SCBC initiated two research projects in the Greater Vancouver area to collect local information about outdoor cats and birds: the Vancouver Cat Count and Greater Vancouver Urban Landbird Count. Engaging with the public and working together are key to the success of projects such as these. Findings from such studies are vital to shaping and informing city policies for keeping cats and birds safe.

Currently, options such as outdoor enclosures (catios), leash walking, and BirdBeSafe cat collars are available for use by owners to reduce the predation of birds by their pets. The SCBC has also developed resources such as guides and reports for owners, veterinarians, and local governments to use to become better informed on the relationship between cats and wildlife in the urban matrix. Most resources recommend monitoring pets while outside, placing bird feeders at least 2 m off the ground, and keeping cats indoors during nesting season (March through August) when young are most vulnerable.

Bird Nesting boxes

Birds contribute to high levels of biodiversity by providing important ecosystem services such as dispersal of seeds, reducing disease transmission, and providing pollinator services. The City of North Vancouver recognizes the role it plays in creating the conditions for native birds to thrive in the City while facilitating the dynamic relationship between people and nature. Public and private land provides habitat that benefits many resident and migratory populations. We can support these species through protecting, enhancing, and creating habitats for native species.

Nesting structures, such as nesting boxes, have proven to be beneficial to local bird populations because development has reduced the availability of habitats these species would normally use as nesting sites. According to the State of Canada's Birds 2012 report, habitat loss due to human settlement, industry, and forestry has caused a 35% decline in a sample of bird species in Canada's Pacific Coast region since 1970. People may choose to build nesting structures for songbirds, owls, or for local species at risk such as the barn swallow. Preliminary research should be done before building a nesting structure to ensure that the size, height, and type of the structure will be suitable for the chosen species.

Public and private land can be turned into useful habitat for birds by providing food, shelter, and water. Nesting structures are most effective when built to accommodate specific bird habitat qualities. When building a nesting structure, think about which type of bird species your local habitat type can provide for. For example, barn swallows, marsh wrens, and red-winged blackbirds prefer to be near water while Wilson's warblers and purple finches prefer deciduous forest. While nesting structures provide a safe space for birds to have young, a diversity of plants for foraging and a source of freshwater should be nearby.

A bird nesting box installed on a wildlife tree at Moodyville Park.

To keep these birds safe while they use the nesting structure and surrounding habitat, all pet cats should be kept indoors. Dogs should be kept on a leash unless in an off-leash area to minimize disturbance to ground-nesting species. Additionally, mortality from bird collisions with glass can be greatly reduced by using blinds or drawing curtains to reduce reflections so that windows are not misinterpreted by birds as open flyways. To encourage birds to use the nesting structure every year they should be sealed until the start of the breeding season. Nesting material should be removed, and the structure cleaned with mild soapy water between breeding seasons.

Rooftop gardens can provide pollen for species such as the rufous hummingbird.

Enhance habitat in high-density developments

High-density developments that typically cover large areas of a property limit the space available for wildlife habitat. There are, however, opportunities in landscaped areas to install habitat features such as ponds or bioswales that are not feasible on smaller residential lots. On buildings themselves, engineered habitats can provide space for birds and insects. These include plantings on roofs and balconies and green walls. The impacts of large buildings on wildlife can be mitigated through implementing wildlife-friendly design and building materials.

Table 6. Recommendations to enhance habitat in high-density developments.

STORMWATER - INCORPORATE GREEN INFRASTRUCTURE FOR THE STORING, CLEANING AND REUSE OF STORMWATER
• Provide incentives for the retention and filtration of stormwater on site as water features incorporated into landscaping. • Provide incentives to capture rainwater to irrigate landscaping. • Continue to encourage and provide incentives for the incorporation of green infrastructure for capturing and cleaning stormwater including green roofs, bioswales, green walls and planters.
LANDSCAPING - ENCOURAGE NATURESCAPEING AND THE CREATION OF NON-TREATED WATER SOURCES
• Provide water sources such as birdbaths. • Install light reduction techniques such as directing light away from natural areas, and reducing spill lighting. • Encourage residents to install anti-collision products on windows and to keep plants away from windows. • Educate cat owners on the impacts of cat predation and options for reducing those impacts.
STRUCTURES - REQUIRE NEW BUILDINGS TO INCLUDE HABITAT FEATURES AND TO MINIMIZE IMPACTS TO BIRDS
• Require buildings to incorporate some habitat including green roofs, green walls or rooftop planter gardens. • Minimize light pollution by directing lighting away from green spaces. • Require bird-friendly windows by installing anti-collision products.

Aerial view of the armored marine foreshore along Kings Mill Walk Park.

Restore the marine waterfront

The marine foreshore has been highly disturbed from its natural state from a long history of armouring and industrial activity. The intense use of this waterfront and the mix of jurisdictional boundaries limits the City's ability to restore it. There have been successful improvements planned along with the development of waterfront areas and the construction of the Spirit Trail. Smaller opportunities that are feasible along the foreshore include the planting of trees and the installation of pocket planting within riprap. Many birds are adapted to the foreshore and will nest in artificial boxes and make use of perch structures. To enhance habitat for marine species, overhanging structures can be installed at and just below the high-tide line.

Table 7. Recommendations to restore the marine waterfront.

RESTORATION - NATURALIZE THE MARINE FORESHORE
• Establish a marine waterfront DPA to minimize the impacts of future waterfront development, and enhance previously degraded foreshore areas. • Install pocket planting of vegetation in rip rap. • Promote green shores approaches to foreshore armouring. • Increase the cover of trees along marine foreshore areas. • Install raptors perches and nesting structures. • Install habitat structures that provide shading and overhanging structures along the foreshore.

The great blue heron relies on the marine shoreline to forage for food.

Leaves decomposing on lawns provide valuable organic and nutrient inputorganic and nutrient input.

Educate residents and promote stewardship of natural areas

The majority of the land in the City is privately owned and outside of the City's jurisdiction. The enhancement of these areas to better support wildlife relies on the stewardship of those landowners. The City can encourage landowners to naturalize parts of their yards, reduce impacts on adjacent natural areas and provide habitat features that are missing in urban landscapes. Educational materials can be developed that are specific to the climate and ecosystems in North Vancouver. These could provide specific planting palettes and landscaping features to create habitat for birds and insects in private yards. Information can also include ways to reduce wildlife impacts such as the use of bird-friendly windows, limiting pesticide and herbicide use and managing cats.

Residents also play an important role in overseeing and monitoring the state of natural area parks. Citizens should be empowered to monitor the state of natural areas and to participate in enhancement and maintenance programs. The City started the Park Stewardship Program in 2001 and has successful hosted annual events with citizens to remove invasive species and plant native plants and trees in natural area parks. This program has been successful and well attended. These events have a direct benefit to natural areas and provide a platform to engage and educate interested citizens.

The City could host educational events focusing on the enhancement of biodiversity in the City. These would offer information regarding the current state of biodiversity in the City, provide educational materials on ways to enhance biodiversity on private and parkland, and facilitate crafting events for building bird or bat nesting boxes. This event could be coordinated with the annual Earth Day events that is hosted by the City.

Education and engagement of youth in the City will instill a sense of lifelong pride in the natural areas of the City. High school students require volunteer hours in order to graduate and as application requirements for many post secondary institutions. The City could coordinate with high schools to engage students in park restoration projects. The building of bird and bat boxes could be coordinated with high school wood working programs.

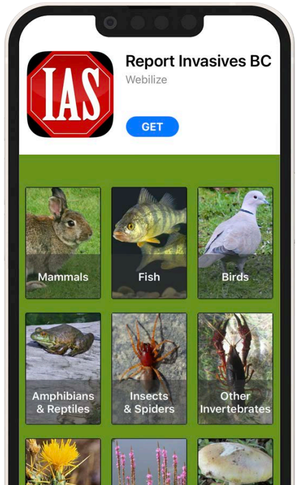
Promoting tree planting on private lands will increase the tree canopy cover across the City. A tree sale or giveaway event could be hosted as part of Canada National Tree Day in September.

Table 8. Recommendations for education and stewardship.

INFORMATION AND ENGAGEMENT - PROVIDE INFORMATION THAT IS ACCESSIBLE BY ALL RESIDENTS ON THE CITY'S STATE OF BIODIVERSITY AND CONTINUE PROVIDING OPPORTUNITIES FOR RESIDENTS TO ENGAGE IN ENHANCING NATURAL AREAS WITHIN THE CITY
• Initiate subsidies and incentives for tree planting on private lands. This could include a tree sale event hosted on National Tree Day. • Host an annual biodiversity event on Earth Day. • Support stewardship programs focusing on private lands that encourage residents to enhance wildlife habitat on their properties. This includes educational materials for naturescaping, conversion of lawns, reuse of rainwater and City lead craft programs for building bird and bat nesting boxes. • Encourage privately managed projects to naturalized and maintain boulevard areas. Develop guidelines for plant communities that the City would support. • Support school and summer programs that educate and encourage students to learn about biodiversity and natural areas in the City, such as volunteering in community gardens. • Maintain a biodiversity webspace with updated information about local parks, stewardship opportunities, and the state of wildlife in the City. • Encourage residents to report invasive species within the City either by email or through the mobile app Report Invasives. • Coordinate with the school system to promote opportunities for youth to volunteer in park restoration projects and community gardens and to build bird and bat boxes as part of the woodworking curriculum. • Continue to expand the Park Stewards program to involve local communities in taking care of natural areas.

Coexisting with wildlife

As an urban area located at the interface of wilderness, the North Shore is no stranger to wildlife. While encountering animals in the wilderness on a hike is more common, seeing a bear, cougar, or coyote within city limits can be alarming. The City's abundant streams, forests, and green spaces provide suitable habitats to support these large animals. Cougar sightings on the North Shore are rare, but encounters with coyotes and bears are relatively frequent. The linear corridors that follow the rivers in the City provide a safe travel corridor to the North Shore mountains. Bears have even been observed in the dense urban communities of Central and Lower Lonsdale. In the search for fish, nuts, and berries, black bears are often attracted to the curbside bins in our alleys on collection day. To prevent this, City of North Vancouver Bylaw No. 6920 provides guidelines for managing solid waste. This bylaw requires residents to bring in solid waste bins overnight and ensure that these containers are built to prevent wildlife access.



While the City of North Vancouver has no formal policy for the large mammals that make their way through our neighbourhoods, the North Shore Black Bear Society works with local governments to provide outreach and educational resources on how to coexist with bears, coyotes, and cougars. These include presentations at schools, canvassing in hot-spot communities, and mailing "Welcome to Bear Country" handouts to new homeowners. Residents are encouraged to report sightings to the North Shore Bear Hotline, and in the case of a threatening or persistent bear, to call the Conservation Officer Service.

Cycle path on Grand Boulevard.

Monitor the state of biodiversity for change

There will be continued threats to the natural areas in the City as it grow and our continues to climate changes. Adopting the recommendations in this Strategy will help to preserve the existing state of biodiversity and hopefully increase its level over time. It is difficult to predict how natural areas will react to the influences of urban development, climate change, pests, disease and invasive species. Monitoring the state of natural areas and wildlife in the City will help the City to track the success of this strategy and to adapt to these threats.

A set of environmental indicators should be adopted and tracked annually by the City to monitor the state of natural areas and wildlife populations. Indicators can include umbrella species whose presence indicates that the habitat that is present is suitable to support many other species. Other indicators can include pest and disease levels or symptoms of decline such as trees dying. They can also include habitat condition such as tree canopy cover, water quality parameters, and the presence of wildlife trees.

Table 9. Umbrella species and monitoring methods.

INDICATOR SPECIES	HABITAT TYPE	SURVEY METHOD
Song sparrow (*Melospiza melodia*)	Shrub communities	Singing birds
Anise swallowtail (*Papilio zelicaon Lucas*)	Pollinator communities	Visual survey for adults
Ruby-crowned kinglet (*Regulus calendula*)	Deciduous Forests	Singing birds
Swainson's thrush (*Catharus ustulatus*)	Deciduous Forests	Singing birds
Red-breasted nuthatch (*Sitta canadensis*)	Coniferous Forests	Singing birds
Barred owl (*Strix varia*)	Coniferous Forests	Call back surveys
Pileated woodpecker (*Dryocopus pileatus*)	Mixed Forests	Evidence of foraging
Common yellowthroat (*Geothlypis trichas*)	Wetlands	Singing birds
Cutthroat trout (*Oncorhynchus clarkii*)	Freshwater river	Minnow Traps/Snorkel survey
Coho salmon (*Oncorhynchus kisutch*)	Freshwater river	Minnow Traps/Snorkel survey

Table 10. Recommendations to monitor the state of biodiversity.

MONITORING - IDENTIFY AND MONITOR THE STATE OF BIODIVERSITY THROUGH THE ASSESSMENT OF INDICATOR SPECIES AND NATURAL AREAS CONDITION TARGETS
• Currently, the City has a canopy cover of 20%. Adopt a monitoring plan within the Urban Forest Strategy to increase the canopy with a specific target and timeline. Canopy should be monitored periodically using LiDAR/orthophotos. Detailed methodologies for monitoring tree canopy cover will be provided in the Urban Forest Strategy update. • Currently, the City has an average impervious surface cover of 65%. Adopt a target to reduce this within City-owned lands. Impervious surface cover should be monitored every 5 years using LiDAR/orthophotos. • Identify umbrella species within the City and monitor their abundance and distribution. Recommended species are provided in Table 9. • Encourage residents to participate in biodiversity monitoring activities. This could be coordinated with the City's Earth Day event. • Record and re-measure the area of Natural Habitat Network periodically to ensure there is no net loss of its habitat. • Continue to support local environmental groups in monitoring and data collection efforts. • Continue to monitor the presence of invasive plant species across the City. • Continue to monitor water quality in streams with fish habitat. Methods should follow those recommended in the City's ISMP and Metro Vancouver's "Monitoring Adaptive management Framework." These include benthic invertebrates, turbidity, temperature, dissolved oxygen, pH, conductivity, nitrate, E. coli, fecal coliforms, iron, copper, lead, zinc, and cadmium. The City has been carrying out benthic invertebrate monitoring since 2000.

Table 11. Recommendations for policy and planning.

DEVELOP, REVIEW AND UPDATE HIGH LEVEL PLANS AND DEVELOPMENT PERMIT AREAS TO ENHANCE AND PROTECT NATURAL AREAS FROM THE IMPACTS OF DEVELOPMENT.
• Recognize the Natural Habitat Network (NHN) for protection and enhancement within the OCP. Adopt and regulate an Environmental Development Permit Area (EDPA) for the NHN to protect remaining public-owned natural areas and the network corridors from adjacent development impacts. • Adopt an Environmentally Sensitive Area Development Permit Area that protects natural park areas from adjacent development. • Review and update the Streamside Development Permit Area and associated development guidelines. • Adopt and regulate an Environmental Development Permit Area (EDPA) for the NHN to protect remaining public-owned natural areas and the network corridors from adjacent development impacts. • Establish a marine waterfront DPA to minimize the impacts of future waterfront development and enhance previously degraded foreshore areas. • Acquire and naturalize new parkland in and adjacent to the NHN. Areas should be prioritized that improve the connectivity between large natural areas and that provide habitat for species at risk. • Explore financial tools to fund the long term acquisition of lands to enhance the NHN. • Encourage density bonusing and clustering to move development away from the NHN. • Update the 2007 Urban Forest Management Plan and include targets for the protection of tree canopy. • Develop Park Management Plans for all-natural parks in the City. • Update the Parks and Greenways Strategic Plan to increase tree and ground vegetation cover along the “Green Necklace and Waterfront Trail” systems. • Continue to implement the Community Wildfire Protection Plan.

Policy recommendations

Under the Local Government Act, the City has the authority to protect natural areas and natural features through land use planning and the regulation of development. This is accomplished by a suite of policies. At a higher level, land use is regulated by the Official Community Plan (OCP) which sets the overarching vision for the City and regulates growth, land use, and density. The OCP and other high-level policies and plans establish goals and principles to be enforced by more targeted planning tools. These polices and plans can be used to recognize and protect the natural habitat network and encourage environmentally friendly development. Tools such as bylaws and development permit areas that regulate development at a site level ensure development supports biodiversity and protects environmentally sensitive areas. Tree protection, soil movement, landscaping, pesticide use, and stormwater management are often addressed through these tools.

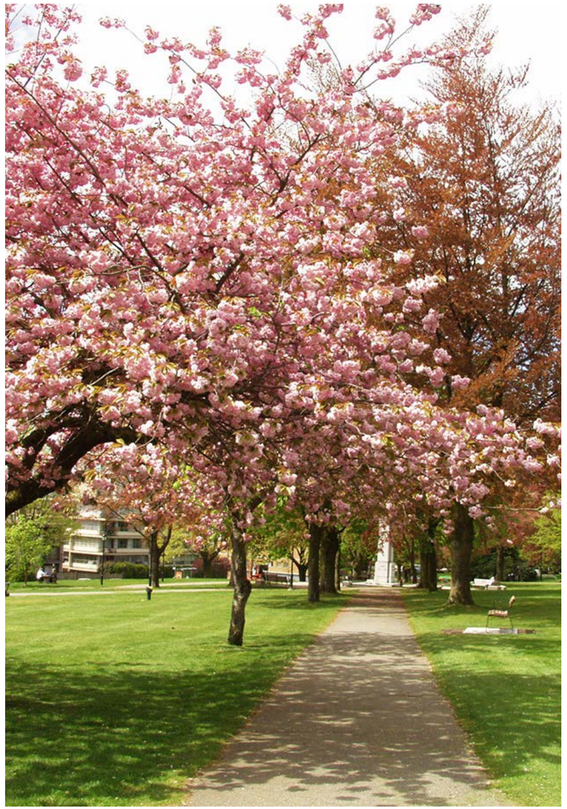
In the City of North Vancouver, the urban landscape has largely been built up and significant natural areas are well protected as parks. There are fewer opportunities for natural area protection and enhancement on large land parcels as most have been developed. More opportunities exist within bylaws and development permit areas to protect and enhance natural elements on private properties.

The City has developed an effective toolkit of policies for managing natural areas and functions. There are however additional opportunities to strengthen the City’s policies to protect and enhance natural areas. Policy considerations that could support the implementation of this report are found in table 12. Increased protection and enhancement through policy requires that there are resources to enforce them and monitor their effectiveness. Along with these policy considerations, additional monitoring and enforcement capacity is required.

Bylaws are tools that cities use to regulate and control activities. Many require permits with fines that can be issued if the terms of the permit are not followed. They can prohibit certain activities and require that certain standards or methods be used. Bylaws are important tools used to regulate activities as they have the ability to issue fines. In addition to issuing permits with requirements, bylaws allow Cities to react to unauthorized activities such as the cutting of a tree or moving soils.

Table 12. Recommendations for bylaws.

BYLAWS - REVIEW AND UPDATE BYLAWS SO THAT THEY EFFECTIVELY REGULATE CHANGES IN AND AROUND NATURAL AREAS AND HABITAT FEATURES.
• Strengthen the Tree Bylaw so that it applies to all zones within the City including Single-Family and Duplex Dwellings. • Include wildlife trees as a protected element under the Tree Bylaw. • Update the Cosmetic Pesticide Use Control Bylaw to meet current regulations and reduce pesticide use across all lands in the City.



Victoria Park.

The City should develop and provide best management practices, guidelines and standards that are specific to the natural areas and urban landscape of the City. They should include recommendations for the restoration of natural areas and nature scaping on private and public lands. The contents or reporting that is submitted as a part of Development Permit Areas should be specified to clarify expectations and improve City staff's ability to review them. Best management practices should include restrictions during certain times of year such as the bird nesting season and sensitive periods for fish populations. The location of sensitive species and habitat elements such as species at risk, raptors nests, dens, wildlife trees and trees of significance should be documented and provided by the City to ensure they are considered and protected.

Table 13. Recommendations for best management practices and guidelines.

BEST MANAGEMENT PRACTICES AND GUIDELINES – DEVELOP BMPS GUIDELINES AND STANDARDS SPECIFIC TO THE NATURAL AREAS IN THE CITY
• Establish restoration guidelines for developments adjacent to natural areas. These should include species recommendations, densities, habitat features and maintenance requirements. • Develop nature-scaping design guidelines in partnership with Squamish and Tsleil-Waututh Nations to promote the incorporation of climate change resilient trees and plants. • Develop reporting standards for Qualified Environmental Professionals that standardize DP submissions. • Identify species at risk within the City and protect their critical habitats on City owned lands. • Maintain a spatial inventory of all raptors nests. • Establish a significant tree registry in partnership with Squamish and Tsleil-Waututh Nations. • Discourage the sale of invasive plant species from local stores. • Continue to require that a bird nesting survey be completed as a condition of tree removal permits during the nesting season (March 1 – August 31).

Aerial image of Grand Boulevard.

Development Permit Areas and bylaws provide the tools to protect natural areas and habitat elements. They provide the ability for the City to regulate development, issue penalties and require compensation. Penalties deter infractions and are often more effective as they increase in value. Resources are required to monitor activities and to ensure that these policies are being adhered to.

Table 14. Recommendations for monitoring and enforcement.

MONITORING AND ENFORCEMENT – IMPROVE THE CITY'S ABILITY TO DETECT INFRACTIONS AND REQUIRE COMPENSATION
• Increase resources for staff to monitor for encroachment and degradation of natural park areas. • Increase the penalties for unauthorized removal or damage to trees on City owned property. • Increase performance bonds for the streamside DPA. • If adopted, develop a performance bond for the NHN Environmental DPA. • Increase the penalties for unauthorized development in the Streamside DPA.

8.0

View of Queensborough Elementary School neighborhood.

IMPLEMENTATION

The Metro 2050 Regional Growth Strategy projects that the population will continue to increase in the City of North Vancouver. To support this growth, the City is planning to increase the capacity of existing land uses and provide a compact and complete community. While supporting this densification, the City is committed to protecting the natural environment which provides habitat for a diversity of species and helps make the City more resilient to the impacts of climate change.

The City aims to protect and where possible enhance the natural forests and streams in the City. It will increase the amount and diversity of trees, ground vegetation and habitat features across the urban landscape to encourage wildlife use.

The natural environment is under increasing threat from the direct impacts of densification and the changing climate. A more compact City means that there will be less growing space for trees and plants and less room for water to infiltrate into soils. With climate change, there will be longer periods of drought and heat in the summers and greater intensity storms in the winter. These changing growing conditions may support species that impact our natural ecosystems including invasive plants and animals as well as outbreaks of pests and diseases.

The City recognizes these threats to biodiversity and that it must take steps to mitigate against them. Through this report, the City aims to protect and where possible enhance the natural forests and streams in the City. It will increase the amount and diversity of trees, ground vegetation and habitat features across the urban landscape to encourage wildlife use. The City will work with its citizens to collaborate on the protection and stewardship of these natural areas. On private lands, the City will adopt policies that promote responsible development and will encourage residents to install natural features. The City will monitor the effectiveness of these changes by tracking the state of natural area indicators.

In addition to this report, the City is developing a draft Climate and Environment Strategy and is developing an Urban Forest Plan. All of these plans provide recommendations for the City to implement that will improve the health and integrity of its natural environment.

By recognizing this report and pursuing the recommended actions provided, the City is taking steps to protect, enhance and connect the remaining natural area parks and to enhance biodiversity across its urban landscape. The City will prioritise these recommendations considering the resources it has for their implementation.

APPENDIX 1

RECOMMENDED NATIVE TREES, SHRUBS, FERNS, AND HERBS

Table 15 provides a table with a summary of recommended native trees, shrubs, ferns and herbs that should be considered when restoring natural areas in the City. Some species that are recommended in these tables may be currently showing health impacts from climate change. Examples include western hemlock and western redcedar which are showing signs of drought stress in the region. These species are still suitable to grow in the City as long as they are planted on wetter sites. If available, stock that is genetically adapted to hotter and drier climates should be used.*

Table 15. Recommended restoration species.

SCIENTIFIC NAME	COMMON NAME	RICH AND WETTER SITES	MODERATE DRIER SITES	POLLINATOR SPECIES	CLIMATE ADAPTATION SPECIES
Trees					
Alnus rubra	red alder	X	X		
Betula papyrifera	paper birch	X	X		
Thuja plicata	western redcedar*	X			
Abies grandis	grand fir	X			X
Acer macrophyllum	bigleaf maple	X			
Picea stichensis	Sitka spruce	X			
Populus balsamifera	black cottonwood	X			
Prunus emarginata	bitter cherry	X			
Tsuga heterophylla	western hemlock*	X			
Arbutus menziesii	arbutus		X		X
Quercus garryana	Garry oak		X		X
Pseudotsuga menziesii	Douglas-fir		X		
Shrubs					
Acer circinatum	vine maple	X	X	X	
Oemleria cerasiformis	indian plum	X	X		
Ribes sanguineum	red-flowering currant	X	X	X	
Cornus sericea	red-osier dogwood	X		X	
Crataegus douglasii	black hawthorn	X			
Lonicera involucrata	black twinberry	X			
Physocarpus capitatus	Pacific ninebark	X			
Malus fusca	Pacific crabapple	X		X	
Ribes bracteosum	stink currant	X			
Rubus spectabilis	salmonberry	X		X	
Rubus parviflorus	thimbleberry	X		X	
Salix Sp	willow (Pacific, Scouler, ritka)	X		X	
Sambucus racemosa	red elderberry	X		X	
Spiraea douglasii	hardhack	X			
Amelanchier alnifolia	saskatoon		X	X	X
Corylus cornuta	beaked hazelnut		X	X	
Gaultheria shallon	salal		X	X	
Holodiscus discolor	oceanspray		X	X	X
Philadelphis lewisii	mock orange		X	X	X
Shrubs					
Mahonia aquifolium	tall Oregon grape		X		
Mahonia nervosa	dull Oregon grape		X	X	
Rosa gymnocarpa	baldhip rose		X	X	
Rosa nutkana	Nootka rose		X	X	
Symphocarpos albus	snowberry		X	X	
Vaccinium parvifolium	red huckleberry		X	X	
Lonicera ciliosa	western trumpet Honeysuckle		X	X	X
Rubus ursinus	trailing blackberry	X	X	X	
Ferns					
Athyrium filix-femina	lady fern	X			
Blechnum spicant	deer fern	X	X		
Dryopteris expansa	spiny wood fern		X		
Polystichum munitum	sword fern	X	X		
Herbs					
Claytonia sibirica	Siberian's miner's lettuce	X			
Dicentra formosa	Pacific bleeding heart	X		X	
Maianthemum dilatatum	false lily-of-the-valley	X			
Cornus canadensis	bunchberry	X			
Epilobium angustifolium	fireweed	X	X		
Achlys triphylla	vanilla leaf	X			
Tiarella trifoliata	three leaved foamflower	X			
Trientalis borealis	broad-leaved starflower	X			
Urtica dioica	stinging nettle	X			
Viola glabella	stream violet	X			
Trillium ovatum	western white trillium	X			

Table 16 provides a table with a summary of recommended plants to use in pollinator gardens.

Table 16. Native plants recommended for pollinator gardens.

NATIVE POLLINATOR SHRUBS		NATIVE POLLINATOR HERBS	
Scientific Name	**Common Name**	**Scientific Name**	**Common Name**
Acer circinatum	vine maple	*Asteraceae sp.*	asters
Amelanchier alnifolia	saskatoon	*Lonicera ciliosa*	western trumpet honeysuckle
Cornus sericea	red-osier dogwood	*Phacelia linearis*	threadleaf phacelia
Gaultheria shallon	salal	*Aquilegia formosa*	columbine
Holodiscus discolor	oceanspray	*Allium schoenoprasm*	chives common
Mahonia aquifolium	tall Oregon grape	*Dicentra formosa*	Pacific bleeding heart
Mahonia nervosa	dull Oregon grape	*Fragaria virginiana*	wild strawberry
Philadelphis lewisii	mock orange	*Camassia leichtinii*	great camas
Ribes sanguineum	red-flowering currant	*Lupinus nootkatensis*	lupine
Rosa gymnocarpa	baldhip rose	*Equilobium angustifolium*	fireweed
Rosa nutkana	Nootka rose	*Heliopsis helianthoides*	ox-eyed sunflower
Rubus parviflorus	thimbleberry	*Digitalus purpurea*	foxglove
Rubus spectabilis	salmonberry	*Aster conspicuus*	showy aster
Salix Sp	willow (Pacific, Scouler, Sitka)	*Solidago Sp.*	goldenrod
Sambucus racemosa	red elderberry	*Fragaria vesca*	woodland strawberry
Symphocarpos albus	snowberry	*Eriohyllum lanatum*	woolly sunflower
Vaccinium parvifolium	red huckleberry	*Anaphalils margaritacea*	pearly everlasting
Erica cinerea	heather species	*Achillea millifolium car lanulosa*	western yarrow
Corylus cornuta	beaked hazelnut		
Malus fusca	Pacific crabapple		
Rubus ursinus	trailing blackberry		

Table 17 provides a table with a summary of plants that are considered culturally significant by the Squamish First Nation. This should not be considered an exhaustive list. It has been compiled by Elizabeth Ross.

Table 17. Plants considered culturally significant by the Squamish First Nation.

NATIVE TREES AND PLANTS		NATIVE TREES AND PLANTS	
Scientific Name	**Common Name**	**Scientific Name**	**Common Name**
Urtica spp.	stinging nettle	*Allium cernuum*	nodding onion
Amelanchier alnifolia	saskatoon	*Sagittaria latifolia*	wapato
Vaccimium membranaceum	black huckleberry	*Echinodonitium tycotorium*	indian paint fungas
Gaultheria shallon	salal	*Polypdium glycyrrhiza*	liquorice fern
Vaccimium ovafolium	oval leafed blueberry	*Pinus monticola*	white pine
Vaccinium uliginosum	bog blueberry	*Triglochin maritimum*	arrow-grass
Vaccinium alaskaense	Alaska blueberry	*Fragaria chiloensis*	coastal wild strawberry
Vaccinium membranaceum	mountain bilberry	*Camassia quamash*	blue camas
Vaccimium myrtilloides	Canada blueberry	*Typha latifolia*	cat-tail
Arbutus menxiesii	arbutus	*Equilobium angustifolium*	fireweed
Rosa nutkana	Nootka rose	*Lomatium nudicaule*	indian consumption plant
Rubus parviflorus	thimbleberry	*Perideridia gairgneri*	wild carrot
Rubus spectabilis	salmonberry	*Ledum groenlacndicum*	labrador tea
Oplapanax horridus	Devil's club	*Solidago Canadensis*	golden rod
Sambucus racemosa	red elderberry	*Fragaria vesca*	woodland strawberry
Sambucus canadensis	common elderberry	*Vaccinium oxycoccus*	bog cranberry
Vaccinium parvifolium	red huckleberry	*Osmaronia cerasiformis*	indian plum
Shepherdia canadensis	soap berry	*Prunus emarginata*	bitter cherry
Asarum caudatum	western wild ginger	*Rubus leucodermis*	black cap
Malus fusca	Pacific crabapple	*Tricholoma murrillianum*	pine mushrooms
Rubus ursinus	trailing blackberry	*Achillea millifolium*	yarrow

APPENDIX 2

SPECIES-AT-RISK IN NORTH VANCOUVER

Natural areas in the City of North Vancouver provide a home for some of British Columbia's most at-risk species. Forests, streams, and the marine foreshore all provide valuable habitat in the heavily urbanized surrounding environment. The following is a list of mammals, birds, amphibians and fish that are at risk and could potentially inhabit the City. This should not be considered an exhaustive list, but one that highlights some of the significant species.

Table 18. Species of mammals, birds, reptiles, amphibians and fish that are at risk and may inhabit the City.

COMMON NAME	SPECIES NAME	STATUS
Mammals		
Townsend's mole	*Scapanus townsendii*	Red
Pacific water shrew	*Sorex bendirii*	Red
Long-tailed weasel, *Altifrontalis* subspecies	*Mustela frenata altifrontalis*	Red
Southern red-backed vole, *occidentalis* subspecies	*Myodes gapperi occidentalis*	Red
Townsend's big-eared bat	*Corynorhinus townsendii*	Blue
Fisher	*Pekania pennant*	Blue
Trowbridge's shrew	*Sorex trowbridgii*	Blue
Amphibians		
Red-legged frog	*Rana aurora*	Blue
Birds		
Western grebe	*Aechmophorus occidentalis*	Red
Peregrine falcon, *anatum* subspecies	*Falco peregrinus anatum*	Red
Barn wwl	*Tyto alba*	Red
Black-crowned night heron	*Nycticorax nycticorax*	Red
Green heron	*Butorides virescens*	Blue
Great blue heron, *fannini* subspecies	*Ardea herodias fannini*	Blue
Rough-legged hawk	*Buteo lagopus*	Blue
Band-tailed pigeon	*Patagioenas fasciata*	Blue
Western screech owl, *kennicottii* subspecies	*Megascops kennicottii kennicottii*	Blue
Olive-sided flycatcher	*Contopus cooperi*	Blue
Barn swallow	*Hirundo rustica*	Blue
White-throated swift	*Aeronautes saxatalis*	Blue
American bittern	*Botaurus lentiginosus*	Blue
Black swift	*Cypseloides niger*	Blue
Caspian tern	*Hydrogrogne caspia*	Blue
Double-crested cormorant	*Phalacrocorax auritus*	Blue
Surf scooter	*Melanitta perspicillata*	Blue
California gull	*Larus californicus*	Blue
Purple martin	*Progne subis*	Blue
Fish		
Cutthroat trout	*Oncrohynchus clarkii*	Blue

Red legged frog.

APPENDIX 3

MEASURING RELATIVE BIODIVERSITY

The level of biodiversity that a natural area can support is difficult to measure because it is affected by many complex and dynamic factors. In general, areas that support high levels of biodiversity include those that are large in size, connected to other natural areas, and provide a variety of habitat features including cover habitat, forage and water. Measuring the exact number of species that inhabit an area is also difficult as the vast majority of them are small such as insects and microbiota. To gain an understanding of the relative value of biodiversity across the City, a list of higher-order wildlife was analyzed. This list includes 221 species of mammals, fish, birds, and amphibians (Table 23). It is assumed that the presence of these species is an indicator for the numerous species lower on the same food chain. Each natural habitat type was ranked out of 100 relative to each other based on the number of these species that would be expected to inhabit them (Table 19). Highly disturbed urban habitat cover types were ranked based on professional judgement.

Table 19. Baseline Biodiversity Ranking for each habitat type.

HABITAT	BASELINE BIODIVERSITY RANK
Deciduous forest	100
Mixed forest	100
Evergreen forest	60
Garden	50
Unmanaged shrub (mostly invasive)	40
Armored marine foreshore	30
Urban trees	30
Managed grass	10

The baseline biodiversity ranking for each habitat type indicates the relative number of species that would be expected to inhabit this area if it were in a natural state with no urban development. To account for the influences of urban development, modifiers were applied to each habitat polygon. Patches of habitat that are closely connected were grouped to calculate their collective size. The ranking of these areas was then modified to reflect the size and fragmentation of each patch area. (Table 20).

Table 20. Biodiversity ranking multiplier based on patch size.

PATCH SIZE (HA)	MULTIPLIER
>50	1.0
25-50	0.9
10-25	0.8
2-10	0.6
0.5-2	0.5
0.1-0.5	0.2
<0.1	0.1

The interface zone that links aquatic and terrestrial ecosystems is known as the riparian habitat. These areas are known to support higher levels of biodiversity than their counterparts. The width of this influence depends on the type of terrestrial and aquatic habitats provided. Riparian areas within each habitat type were identified and multiplied by a modifier to reflect their influence on biodiversity (Table 21).

Table 21. Riparian Habitat Modifiers.

WATERCOURSE CLASSIFICATION	WIDTH OF INFLUENCE	MULTIPLIER
Fish-bearing rivers & streams	30 m	1.5
Non fish bearing steams	15 m	1.3
Marine foreshore	30 m	1.5

Areas within the urban interface are often disturbed in ways that reduce their capacity to support wildlife. These disturbances include encroachment from development, dumping, and infestations of non-native species. Each area was modified to reflect their level of disturbance (Table 22).

Table 22. Disturbance Modifiers.

DISTURBANCE CLASSIFICATION	MULTIPLIER
Natural	1.0
Semi-disturbed	0.9
Disturbed	0.6

Robbins eggs.

Table 23. Birds considered to establish a baseline biodiversity ranking.

BIRDS			
Tundra swan	*Cygnus columbianus*	Vaux's Swift	*Chaetura vauxi*
Trumpeter swan	*Cygnus buccinator*	Anna's Hummingbird	*Calypte anna*
Mute swan	*Cygnus olor*	Rufous Hummingbird	*Selasphorus rufus*
Greater white-fronted goose	*Anser albifrons*	Belted Kingfisher	*Megaceryle alcyon*
Snow goose	*Chen caerulescens*	Downy Woodpecker	*Picoides puabescens*
Canada goose	*Branta canadensis*	Hairy Woodpecker	*Picoides villosus*
Wood duck	*Aix sponsa*	Northern Flicker	*Colaptes auratus*
Green-winged teal	*Anas crecca*	Pileated Woodpecker	*Dryocopus pileatus*
Mallard	*Anas platyrhynchos*	Red-breasted Sapsucker	*Sphyrapicus ruber*
Northern pintail	*Anas acuta*	Olive-sided Flycatcher	*Contopus cooperi*
Blue-winged teal	*Anas discors*	Western Wood-pewee	*Contopus sordidulus*
Cinnamon teal	*Anas cyanoptera*	Willow Flycatcher	*Empidonax traillii*
Northern shoveler	*Anas clypeata*	Hammond's Flycatcher	*Empidonax hammondii*
Gadwall	*Anas strepera*	Pacific-slope Flycatcher	*Empidonax difficilis*
Eurasian wigeon	*Anas penelope*	Northern Shrike	*Lanius excubitor*
American wigeon	*Anas americana*	Cassin's Vireo	*Vireo cassinii*
Canvasback	*Aythya valisineria*	Hutton's Vireo	*Vireo huttoni*
Redhead	*Aythya americana*	Warbling Vireo	*Vireo gilvus*
Ring-necked duck	*Aythya collaris*	Red-eyed Vireo	*Vireo olivaceus*
Greater scaup	*Aythya marila*	Steller's Jay	*Cyanocitta stelleri*
Lesser scaup	*Aythya affinis*	Northwestern Crow	*Corvus caurinus*
Harlequin duck	*Histrionicus histrionicus*	Common Raven	*Corvus corax*
Long-tailed duck	*Clangula hyemalis*	Purple Martin	*Progne subis*
Common goldeneye	*Bucephala clangula*	Tree Swallow	*Tachycineta bicolor*
Barrow's goldeneye	*Bucephala islandica*	Violet-green Swallow	*T. thalassina*
Bufflehead	*Bucephala albeola*	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Hooded merganser	*Lophodytes cucullatus*	Bank Swallow	*Riparia riparia*
Common merganser	*Mergus merganser*	Cliff Swallow	*Petrochelidon pyrrhonota*
Red-breasted merganser	*Mergus serrator*	Barn Swallow	*Hirundo rustica*
Ruddy duck	*Oxyura jamaicensis*	Black-capped Chickadee	*Poecile atricapilla*
Ring-necked pheasant	*Phasianus colchicus*	Chestnut-backed Chickadee	*Poecile rufescens*
Ruffed grouse	*Bonasa umbellus*	Bushtit	*Psaltriparus minimus*
Common loon	*Gavia immer*	Red-breasted Nuthatch	*Sitta canadensis*
Pied-billed grebe	*Podilymus podiceps*	Brown Creeper	*Certhia americana*
Horned grebe	*Podiceps auritus*	Bewick's Wren	*Thryomanes bewickii*
Western grebe	*Aechmophorus occidentalis*	Pacific Wren	*Troglodytes pacificus*
Clark's grebe	*Aechmophorus clarkii*	Marsh Wren	*Cistothorus palustris*
Double-crested cormorant	*Phalacrocorax auritus*	American Dipper	*Cinclus mexicanus*
American bittern	*Botaurus lentiginosus*	Golden-crowned Kinglet	*Regulus satrapa*
Great blue heron ssp. fannini	*Ardea herodias fannini*	Ruby-crowned Kinglet	*Regulus calendula*
Green heron	*Butorides striatus*	Swainson's Thrush	*Catharus ustulatus*
Osprey	*Pandion haliaetus*	Hermit Thrush	*Catharus guttatus*

BIRDS			
Bald eagle	*Haliaeetus leuco-cephalus*	American Robin	*Turdus migratorius*
Northern harrier	*Circus cyaneus*	Varied Thrush	*Ixoreus naevius*
Cooper's hawk	*Accipiter cooperii*	European Starling	*Sturnus vulgaris*
Northern goshawk ssp. laingi	*Accipiter gentilis laingi*	American Pipit	*Anthus rubescens*
Sharp-shinned hawk	*Accipiter striatus*	Bohemian Waxwing	*Bombycilla garru-lus*
Red-tailed hawk	*Buteo jamaicensis*	Cedar Waxwing	*Bombycilla cedrorum*
Rough-legged hawk	*Buteo lagopus*	Orange-crowned Warbler	*Vermivora celata*
American kestrel	*Falco sparverius*	Yellow Warbler	*Dendroica petechia*
Merlin	*Falco columbarius*	Yellow-rumped Warbler	*Dendroica corona-ta*
Peregrine falcon ssp. pealei	*Falco peregrinus pealei*	Black-throated Gray Warbler	*D. nigrescens*
Peregrine falcon ssp. anatum	*Falco peregrinus ana-tum*	Townsend's Warbler	*Dendroica town-sendi*
Gyrfalcon	*Falco rusticolus*	MacGillivray's Warbler	*Oporornis tolmiei*
Sora rail	*Porzana carolina*	Common Yellowthroat	*Geothlypis trichas*
Virgina rail	*Rallus limicola*	Wilson's Warbler	*Wilsonia pusilla*
American coot	*Fulica americana*	Western Tanager	*Piranga ludovici-ana*
Sandhill crane	*Grus canadensis*	Spotted Towhee	*Pipilo maculatus*
Dunlin	*Calidris alpina*	Savannah Sparrow	*Passerculus sand-wichensis*
Western sandpiper	*Calidris mauri*	Fox Sparrow	*Passerella iliaca*
Least sandpiper	*Calidris minutilla*	Song Sparrow	*Melospiza melodia*
Short-billed dowitcher	*Limnodromus griseus*	Lincoln's Sparrow	*Melospiza lincolnii*
Long-billed dowitcher	*Limnodromus scolopacous*	White-crowned Sparrow	*Zonotrichia leuco-phrys*
Greater yellowlegs	*Tringa melanoleuca*	Golden-crowned Sparrow	*Zonotrichia atri-capilla*
Lesser yellowlegs	*Tringa flavipes*	Dark-eyed Junco	*Junco hyemalis*
Herring gull	*Larus argentatus*	Black-headed Grosbeak	*Pheucticus mela-nocephalus*
Ring-billed gull	*Larus delawarensis*	Lazuli Bunting	*Passerina amoena*
California gull	*Larus californicus*	Red-winged Blackbird	*Agelaius phoe-niceus*
Mew gull	*Larus canis*	Western Meadowlark	*Sturnella neglecta*
Glaucous-winged gull	*Larus glaucescens*	Brewer's Blackbird	*Euphagus cyano-cephalus*
Band-tailed pigeon	*Columba fasciata*	Brown-headed Cowbird	*Molothrus ater*
Mourning dove	*Zenaida macroura*	Bullock's Oriole	*Icterus bullockii*
Barn owl	*Tyto alba*	Pine Grosbeak	*Pinicola enucleator*
Western screech owl ssp. ken-nicottii	*Otus kennicottii ken-nicottii*	Purple Finch	*Carpodacus pur-pureus*
Great horned owl	*Bubo virginianus*	House Finch	*Carpodacus mexi-canus*
Barred owl	*Strix varia*	Red Crossbill	*Loxia curvirostra*
Short-eared owl	*Asio flammeus*	Pine Siskin	*Carduelis pinus*
Long-eared owl	*Asio otus*	American Goldfinch	*Carduelis tristis*
Northern saw-whet owl	*Aegolius acadicus*	Evening Grosbeak	*Coccothraustes vespertinus*
Black swift	*Cypseloides niger*	House Sparrow	*Passer domesticus*

Table 24. Mammals considered to establish a baseline biodiversity ranking.

MAMMALS			
Virginia opossum	*Didelphis virginiana*	Townsend's vole	*Microtus townsendii*
Pacific water shrew	*Sorex bendirii*	Muskrat	*Ondatra zibethica*
Trowbridge's shrew	*Sorex trowbridgii*	Beaver	*Castor canadensis*
Olympic shrew	*Sorex rohweri*	Northern flying squirrel	*Glaucomys sabrinus*
Cinereus (common) shrew	*Sorex cinereus*	Gray squirrel	*Sciurus carolinensis*
Dusky shrew	*Sorex monticolus*	Douglas squirrel	*Tamiasciurus douglasii*
Vagrant shrew	*Sorex vagrans*	Townsend's chipmunk	*Neotamias townsendii*
Shrew-mole	*Neurotrichus gibbsii*	Pacific jumping mouse	*Zapus trinotatus*
Western long-eared myotis	*Myotis evotis*	House mouse	*Mus musculus*
Keen's long-eared myotis	*Myotis keenii*	Norway rat	*Rattusnorvegicus*
Little brown myotis	*Myotis lucifugus*	Roof rat, black rat	*Rattus rattus*
California myotis	*Myotis californicus*	Coyote	*Canis latrans*
Long-legged myotis	*Myotis volans*	River otter	*Lontra canadensis*
Yuma myotis	*Myotis yumanensis*	Marten	*Martes americana*
Hoary bat	*Lasiurus cinereus*	Fisher	*Martes pennanti*
Townsend's big-eared bat	*Plecotus townsendii*	Striped skunk	*Mephitis mephitis*
Big brown bat	*Eptesicus fuscus*	Ermine ssp. fallenda	*Mustela erminea fallenda*
Eastern cottontail	*Sylvilagus floridanus*	Long-tailed weasel ssp. altifrontalis	*Mustela frenata altifrontalis*
Snowshoe hare ssp. washingtonian	*Lupus americans washingtonian*	Mink	*Mustela vison*
North American deer mouse	*Peromyscus maniculatus*	Spotted skunk	*Spilogale putorius*
Southern red-backed vole ssp. occidentalis	*Myodes gapperi occidentalis*	Raccoon	*Procyon lotor*
Long-tailed vole	*Microtus longicaudus*	Black bear	*Ursus americanus*
Creeping vole	*Microtus oregoni*	Mule deer ssp. columbianus	*Odocoileus h. columbianus*

Table 25. Amphibians and reptiles considered to establish a baseline biodiversity ranking.

AMPHIBIANS AND REPTILES			
Western toad	*Anaxyrus boreas*	Western red-backed salamander	*Plethodon vehiculum*
Pacific treefrog	*Pseudacris regilla*	Rough-skinned newt	*Taricha granulosa*
Northern red-legged frog	*Rana aurora*	Painted turtle - Pacific Coast population	*Chrysemys picta*
Green frog	*Rana clamitans*	Northern alligator lizard	*Igaria coerulea*
American bullfrog	*Rana catesbeiana*	Northwestern garter snake	*Thamnophis ordinoides*
Northwestern salamander	*Ambystoma gracila*	Common garter snake	*Thamnophis sirtalis*
Long Toed salamander	*Ambystoma macrodactylum*	Western garter snake	*Thamnophis elegans*
Ensatina	*Ensatina eschscholtzii*		

Bushtit birds construct hanging nests.

North American racoon

APPENDIX 4

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Stellar Jay.

city of north vancouver