

BIODIVERSITY CONSERVATION STRATEGY

PRODUCED BY DIAMOND HEAD CONSULTING - JANUARY 2014



Acknowledgments

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Finally we would like to thank the citizens of Surrey for their ongoing support for the conservation of their natural environment.



On the cover:
white barrel
bird's nest
Nidula niveo-
tomentosa

On this page:
Pseudotsuga
menziesii
Douglas-fir



View north from Colebrook Road and 127A St

Executive Summary

Surrey is located in one of the most livable urban areas in the world. This success is owed partly to the region's rich biodiversity (i.e. nature) which first attracted First Nations and later, European settlers, to the region. Population growth and development over the past century has transformed Surrey; however, the City retains much of its natural heritage. Today, citizens still enjoy and benefit from having nature in the City.

This *Biodiversity Conservation Strategy* (BCS) recognizes Surrey's biodiversity as a key foundation of a healthy, livable and sustainable community. Preserving nature (including plants, wildlife, and ecological values and functions) provides many benefits: clean air and water, improved health and livability, reduced infrastructure, and aesthetic and recreational value.

The goal of this Strategy is to preserve Surrey's biodiversity over the long term. As part of this process, stakeholders and the public assisted the City and consulting staff to identify important places, values, and challenges for biodiversity. This information was used to help evaluate the current state of biodiversity, prioritize options for conservation, and develop appropriate management strategies and policies.

Habitat loss fueled by population growth and land development is the greatest risk to Surrey's biodiversity. Invasive species, climate change, pollution, and other types of human activity are also concerns. Preserving and restoring habitat (natural areas) is essential, as is demonstrating the value and importance of conserving biodiversity to the community.

Surrey has some tools to manage for biodiversity, but there are limitations. Municipal powers granted under the Local Government Act include the ability to acquire land/funds through parkland dedication or other mechanisms (development levies), enact bylaws (e.g. tree protection, floodplain

development), set conditions for development (e.g. increased density, environmental setbacks), and establish conservation easements. High land costs and existing development approvals reduce opportunities to acquire land for biodiversity conservation. Outside of the municipal and regional park system and protected riparian corridors, the majority of the City's remaining natural areas are located on private land. The City also has limited ability to regulate lands within the Agricultural Land Reserve (which covers approximately one third of Surrey). Cooperation will be required between the City, developers and the general public to achieve objectives.

Maintaining large, contiguous natural areas is important to maintain biodiversity, as is preserving a variety of habitats that support different species of plants, wildlife and other organisms. However, all land cannot be protected, particularly in urban areas where there are many demands on limited space. Therefore, a focused approach is necessary to ensure land is optimized for biodiversity conservation. A Green Infrastructure Network (GIN) has been identified and forms the backbone of the Strategy. A GIN is an interconnected network of protected open space and natural areas that conserves ecosystem values and functions and provides benefits to people and wildlife (Benedict and McMahon, 2006). The GIN will conserve important habitat and guide future land acquisition, development, and other management actions.

The proposed GIN includes natural areas, parks, streams, riparian areas, and natural corridors that together function as a system of "hubs", "sites", and connecting "corridors".

These include forests, streams/lakes, wetlands, marine foreshore, oldfields, agricultural land, and urban environments. Immature forest types are the most abundant natural habitat type, and comprise almost 15% of the City's

landbase. The GIN includes a variety of these habitat types to ensure that major species guilds (i.e. group of organisms that have similar habitat requirements) are supported.

Land outside the GIN consists of developed areas (the urban matrix) and agricultural land. Most of the urban matrix is private land, while a portion (e.g. boulevards and street trees) is managed by the City. These areas are also home to a diversity of plants and wildlife. Development Permit Areas (DPAs) are recommended for land next to the GIN. The DPAs recognize the value of the GIN and adjacent lands and require developers to work with the City to develop in a sustainable manner that protects and enhances biodiversity.

A Biodiversity Checklist is provided that can be integrated with the City's Sustainability Checklist to help guide development elsewhere in the urban matrix. The Checklist specifies different features (e.g. green walls, bird boxes, naturescaping) that developers and homeowners can choose from to enhance local biodiversity on private land.

Management Areas have been designated that recognize the unique conditions (e.g. geography, climate, land use, habitat quality/quantity) that influence biodiversity across the City. Representative wildlife species were selected to guide management decisions in different management areas, based on specific habitat requirements of these species. For example, deer are a target management species in suburban areas of South Surrey. Indicator species were identified as part of a long term biodiversity monitoring strategy to help assess development impacts to ecological integrity, identify changes in biodiversity, and evaluate management actions.

Policy and management recommendations in the BCS support the City's two guiding policy documents: the *Official Community Plan* (OCP) and the *Sustainability Charter*. Much of the language in the OCP and *Sustainability Charter* reflects the growing emphasis the City places on environmental protection, biodiversity, green infrastructure and sustainable development. Although the recommendations in this BCS focus on biodiversity, many also relate to building and site design, infrastructure, recreation, food production, climate change, and human health. The goal is to emphasize the important interrelationship between biodiversity and sustainability.

Performance criteria and indicators have been established to monitor and assess Surrey's progress towards meeting its own specific biodiversity management objectives. Many of these measures support key City objectives, such as implementation of the GIN or ensuring an effective policy framework is in place to support City initiatives. Due to the unique challenges of the urban environment, and the potential for significant environmental change in the future, adaptability is a key component of this Strategy.

Recognized as Metro Vancouver's fastest growing City, Surrey is also known as the "City of Parks." The BCS is developed as a shared vision for conservation and is designed to facilitate cooperation amongst public and private sector leaders, and citizens. It acknowledges biodiversity as a foundation for a healthy, livable, sustainable, and resilient community and offers a clear and operable roadmap to preserve the natural environment while accommodating urban growth objectives.

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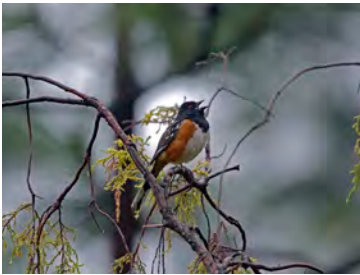
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Biodiversity & the City of Surrey

Biodiversity is defined broadly as the variability of life on earth and the ecological processes that support it.



Pipilo maculatus Spotted towhee by Dean O'Dea

Conserving biodiversity is critical to the long-term health, prosperity and security of Canadians” (Environment Canada, Internal Briefing Notes 2013

The City of Surrey (the “City”) is located in one of the fastest growing, most populous regions in Canada. The Lower Mainland is considered one of the most livable urban regions in the world. Much of this success is owed to the rich biodiversity that attracted First Nations and later, European settlers, to the region. Although population growth, development and land use changes over the past century has transformed Surrey, the City still maintains much of its natural heritage. Today, citizens still enjoy and benefit from the abundance of large protected natural areas found throughout the City.

As Surrey progresses into the 21st century, there is a renewed emphasis on preserving biodiversity and natural areas. Changing times requires a new approach to urbanization, with an increasing emphasis on sustainability. Recognizing the role biodiversity plays to support sustainable growth is an important component of this transition. *This Biodiversity Conservation Strategy* (“Strategy”) is the culmination of many years of work and consultation with civic leaders, municipal staff, First Nations, environmental and industry stakeholders, and the public. This Strategy provides a long-term vision that will ensure the preservation of biodiversity as a key foundation of a healthy, livable and sustainable community. The

Strategy also places Surrey amongst the most progressive cities in the world.

WHAT IS BIODIVERSITY?

Biodiversity is defined broadly as the variability of life on earth and the ecological processes that support it.

“nature.” The goal of this Strategy is to conserve nature within our urban environment.

Addressing biodiversity conservation in environmental management and land use planning can be challenging. Identifying and inventorying the innumerable genes, species

UN Convention on Biological Diversity (1993) - Article 2

...the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Canadian Biodiversity Strategy (1995)

...the variety of species and ecosystems on Earth and the ecological processes of which they are a part.

Biodiversity BC

...the variety of species and ecosystems on earth and the ecological processes of which they are a part, including ecosystems, species and genetic diversity components.

Biodiversity Conservation Strategy Partnership (Metro Vancouver, 2008)

...the variability among living organisms which includes the diversity within species, between species and among ecosystems.

The term “biodiversity” is often misunderstood. It can be perceived as being an abstract concept, with minimal applicability to everyday life. Therefore, it is useful to talk about biodiversity in a more tangible way. Simply put, biodiversity can be referred to as

(including micro-organisms, insects, etc) and ecological diversity over large areas is not practical. So, we often work at higher levels, which typically results in management of more visible species, species groups and ecosystems (Gyllin, 2000).



For the purposes of this Strategy, the term “biodiversity” is used as a relative indicator of species abundance and, diversity and habitat quality. Biodiversity was assessed using higher-level species groups (mammals, birds, fish, amphibians, reptiles, and plants) rather than measuring the absolute composition of all organisms. The condition of these species represents the general health of natural habitat and organisms (bacteria, fungi, microorganisms, insects, etc.) that exist within our urban landscape.

WHY DOES BIODIVERSITY MATTER?

Numerous studies have been conducted to determine the value of biodiversity (nature), particularly in urban environments. Thanks to that research, we now realize that the benefits of biodiversity conservation extend far beyond simply preserving wildlife. Increasing biodiversity in urban areas can greatly reduce our “ecological footprint” (Rees, 2001). Nature provides a variety of “free” ecosystem services (Cassady St. Clair et al, 2010) that are of great economic, social and cultural benefit:

Recognizing that individuals value nature differently is crucial to understanding our motivations for conserving and protecting biodiversity (Sattler et al, 2009). Raising awareness of the multiple benefits of biodiversity conservation is essential to gain community support.

BIODIVERSITY IN SURREY AND THE REGION

Prior to European settlement, the region’s mountains, lowlands and floodplains supported stands of old growth forest and expansive wetland habitats. Lakes, rivers, creeks, and estuaries were rich in aquatic life. This wide variety of habitat, influenced by one of the mildest (and wettest) climates in Canada, attracted the region’s earliest residents. First Nations have lived in the area for thousands of years, subsisting on the ample supply and diversity of fish, wildlife and plants. Over time, urbanization of the Lower Mainland has resulted in changes to the landscape and extirpation of some species such as grizzly bear, Roosevelt elk and grey wolf. However, there is still a remarkable diversity of wildlife that makes its home in the region for all or part of the year.



The Fraser River estuary (including lowland areas of Surrey) was recognized on the world stage in 2012 as a “Ramsar Wetland of International Importance.”

Today, the Fraser Valley is one of the fastest growing and most developed areas in the country. As a major port and railway hub, it facilitates the movement of goods throughout Canada and the Pacific Rim. Despite these changes, the region retains its international importance as a commercial fishery and seasonal home to millions of migrating birds who travel the Pacific Flyway each year.

Surrey is positioned on the Fraser River Estuary, one of the richest ecosystems in the world. This estuary was recognized on the world stage in 2012 as a “Ramsar Wetland

of International Importance.” The extensive mudflats of South Surrey compose part of the Boundary Bay - Roberts Bank - Sturgeon Bank IBA (Important Bird Area), globally renowned for the abundance of waterfowl and shorebirds. The Fraser River itself has the fifth largest drainage area in Canada and is the most productive salmon river on the Pacific West Coast.

Surrey’s history as a farming community, reflected in low density rural and suburban neighbourhoods and the Agricultural Land Reserve, has been beneficial for maintaining

biodiversity. This has resulted in retention of a large proportion of natural and semi-natural area, including forests, old fields, streams and wetlands. Although urbanization has resulted in some changes, the City has been proactive in conservation. The City maintains an open drainage system and has preserved the majority of its original watercourses, many of which are fish-bearing. Collectively, these habitats support a wide range of plants, birds, mammals, fish, reptiles, amphibians and innumerable invertebrates and micro-organisms

“The health of humans, animals, plants and their surroundings are inextricably linked. Humans are part of the systems, not apart from them.” International Association for Ecology and Health, 2011

Why does biodiversity matter?

- **Water and air quality** - natural ecological processes provide drinking water and breathable air;
- **Absorption and removal of pollutants** - urban trees, plants and wetlands act as a natural filter for airborne, overland and subsurface pollutants;
- **Stormwater and flood management** - wetlands and trees reduce the run-off impact of heavy rains and can absorb and store water;
- **Temperature moderation** - trees provide shade and help moderate the urban heat island effect;
- **Crop pollination** - bees and other pollinators are essential for crops;
- **Food production** - trees and plants can be important for local food production;
- **Recreation** - natural habitat provides opportunities for recreation;
- **Human health** - access to nature in urban areas reduces stress and improves psychological and physical well being; it has also been shown to increase workplace productivity;
- **Aesthetic/Experiential** - Trees, gardens, and natural areas are prominent aesthetic features of the urban environment; for many urbanites, they are their only opportunities to experience nature;
- **Spirituality** - biodiversity is a critical component of our culture and religion; it is of particular importance to First Nations.

MANAGEMENT CONTEXT FOR URBAN BIODIVERSITY

The United Nation's Convention on Biological Diversity (CBD) was ratified in 1992 at the Rio Earth Summit. This landmark agreement recognizes the global importance of biodiversity for human health, economic and social development and sustainability. As a signatory of the CBD, Canada was required to submit a national response.

The *Canadian Biodiversity Strategy* provides a national perspective to implementing the CBD, recognizing jurisdictional limits as defined under the Constitution. Similarly, the Province of British Columbia initiated a regional assessment of biodiversity. The *Status of Biodiversity in British Columbia* (2008) provides an overview of ecosystems, species and genetic diversity in the province and identifies specific threats including human activities.

Since 1992, attention has focused on rapid population growth and development in urban areas and its effects on local and regional biodiversity. In 2008, the critical role of cities and local authorities to help implement the CBD was

formally recognized by the United Nations. This recognition led to the development of *A Plan of Action on Sub-National Governments, Cities and Other Local Authorities for Biodiversity*, which was adopted in 2010. This Plan forms the basis of the *Cities and Biodiversity Outlook*, a program focusing on the important relationship between urban areas and biodiversity. The *Cities and Biodiversity Outlook* has 10 key messages to guide sustainable urbanization and development.

Surrey recognizes that preserving biodiversity is essential to community sustainability. The City's *Sustainability Charter* was adopted in 2008 articulating a vision for the future. It begins by stating:

"Surrey values and protects its natural environment through stewardship of its rich tree canopy, and enhancement of its natural areas and biodiversity..."

The *Sustainability Charter* has many goals and actions to support environmental sustainability and biodiversity. Summaries of biodiversity related goals and actions from

the *Sustainability Charter* can be found in Appendix C. Subsequent City planning initiatives have supported this vision. The *Ecosystem Management Study* (EMS) was completed in 2011. The EMS project mapped and assessed the health of the City's environmental features and vegetation types, in addition to providing options for development of a Green Infrastructure Network (GIN). A GIN is an interconnected system of natural areas and open space that conserves ecosystems and functions, while providing benefits to both wildlife and people (Benedict and McMahon, 2006). This information will be incorporated into the City's *Official Community Plan* (OCP), 2014, to provide general policy direction for future planning and development.

In 2011, Metro Vancouver released a regional growth strategy "Metro Vancouver 2040 - Shaping our Future." This was followed by Metro Vancouver's "Ecological Health Action Plan" which recommended the advancement of a regional level GIN. The City of Surrey's Biodiversity Conservation Strategy is the first comprehensive municipal level GIN that contributes to this regional planning initiative.

10 key messages to guide sustainability



- Unsustainable urbanization is a critical driver behind global biodiversity loss and ecosystem change.
- Rich biodiversity can exist in cities.
- Biodiversity and ecosystem services represent critical natural capital.
- Urban ecosystems contribute significantly to improved human health.
- Incorporating biodiversity and ecosystems in urban planning and design helps reduce carbon emissions and enhance adaptation to climate change.
- Food and nutrition security depend on local and biodiversity-based food systems.
- Ecosystem functions must be integrated in urban policy and planning.
- Successful management of biodiversity and ecosystem services includes all levels and all sectors.
- Cities offer unique opportunities for learning and education about a resilient and sustainable future.
- Cities have a large potential to generate innovations and governance tools and therefore can—and must—take the lead in sustainable development.



Trillium ovatum - Western trillium



Lupinus sp. - Lupine

This *Biodiversity Conservation Strategy*:

- Identifies and quantifies current biodiversity and habitat resources in the City;
- Prioritizes options and establishes management criteria for the Green Infrastructure Network (GIN);
- Specifies management criteria and strategies for urban ecosystems and habitat elements;
- Sets conservation targets for natural areas and indicator species;
- Provides a long term monitoring program that builds on management objectives, criteria and indicators to measure the success of the strategy;
- Recommends policy and procedures that will support the initiatives in the Strategy.



Aegolius acadicus Northern saw-whet owl
by Dean O'Dea

OBJECTIVES FOR BIODIVERSITY MANAGEMENT

One of the key recommendations of the City's *Ecosystem Management Strategy* was to develop a *Biodiversity Conservation Strategy (BCS)*. This initiative is also supported by the *Sustainability Charter* and the *Official Community Plan*.

CHALLENGES FOR BIODIVERSITY CONSERVATION IN THE CITY

The City has specific challenges that must also be acknowledged to effectively manage for biodiversity:

1. Habitat loss. Habitat loss is the number one threat to biodiversity (IUCN, 2012). Construction of roads, buildings, and infrastructure results in smaller habitat patches that are disconnected from one another. Fragmenting habitat affects species that require larger contiguous habitat areas or are less tolerant of disturbance. Habitat fragmentation restricts movement of individuals amongst sub-populations affecting their genetic viability and ability to repopulate areas.

2. Population growth and development pressure.

Surrey's population increased by over 100,000 people from 2001 to 2011, growing to approximately 483,000 residents. The City is expected to add almost 300,000 more people by 2041 (City of Surrey, 2012). Growth and development will continue to place pressure on the amount and quality of habitat in the City.

3. Land prices. Surrey's land prices are amongst the highest in the country. This creates an incentive to subdivide larger parcels and maximize developable area to provide a better return on investment. Often this comes at the expense of habitat.

4. Approved land use plans. Development planned prior to the adoption of this *BCS* may not align with the strategy's recommendations. Amendments to current and future land use and development plans may be required to achieve objectives for biodiversity preservation and establishment of the Green Infrastructure Network.

5. Agricultural Land Reserve (ALR). City of Surrey has limited planning and development controls on ALR land which encompasses approximately one third of the City's land base. As agricultural practices intensify to increase productivity, they can result in mono-cultures and the loss of natural areas.

6. Land acquisition. The City has few options to acquire large tracts of land outside of direct purchase, which is expensive. The *Local Government Act [RSBC 1996]* permits the City, when there is subdivision of land of three or more parcels, to request up to 5% of developable area for parkland or cash in-lieu. There is also a requirement for parkland for active recreation such as soccer fields, playgrounds and water parks, and their supporting structures including parking lots and small buildings. Parkland for active recreation may not be compatible with biodiversity preservation. Remaining parkland after active recreation has been accounted for may be insufficient to preserve biodiversity.

7. Planning and development tools. Planning tools and Provincial legislation to manage for biodiversity and sustainable development are limited, underutilized or not implemented. Surrey's OCP and zoning bylaws may be updated and strengthened to ensure planners have more flexibility, direction, incentive and support to manage for biodiversity.

8. Watercourses and Riparian Areas. Surrey's watercourses provide important habitat for fish and wildlife. Protection of riparian setbacks can meet multiple objectives (e.g. water quality, biodiversity, slope stability, recreation). Current regulations are primarily focused on fisheries protection, and often do not provide adequate riparian habitat for terrestrial wildlife species.

9. Invasive species. Invasive species are a significant driver of biodiversity loss (IUCN, 2012). Numerous invasive plant and wildlife species have established in Surrey. Many of these species are well adapted to urban environments and can outcompete native species.

10. Climate change. Global climatic conditions are changing. Although the reasons are complex, this change is real and its implications are difficult to predict. Climate change will affect existing habitats and their ability to support plant communities and wildlife species.

11. Public Perception. Biodiversity is often associated with expansive natural areas or large animals. However, cities generally do not have that level of biodiversity (Gyllin, 2000). Instead, urban areas have a variety of modified landscapes and micro-habitats (gardens, boulevards, backyard trees) which support smaller wildlife and non-native species. Raising public awareness of the value of these smaller habitats will encourage the protection of nature in "backyards" and other developed areas.

12. Human Disturbance and Interaction: Human caused disturbance, including the activity of pets (e.g. cats, dogs) can have a significant impact on biodiversity. Noise, light, and traffic can affect wildlife behaviour, particularly at sensitive times of the year (e.g. breeding, nesting). Wildlife collisions with vehicles can result in injury and mortality. Pets can harass and predate on birds and other wildlife. Human behaviour around the home (e.g. improper disposal of garbage) can attract wildlife, sometimes with unwanted consequences.

Governance

The regulatory framework for biodiversity is separated into federal, provincial and municipal levels. Each level of government has different powers and responsibilities, which influence land use and development. The City works with government agencies and other municipalities to achieve local and regional goals, including those related to biodiversity conservation. Occasional changes in the regulatory framework necessitate regular review of municipal plans and by-laws to ensure compliance and that all management options available are understood. A summary of applicable regulations, plans and by-laws is included in Appendix D.

Consultation

The success of the *Biodiversity Conservation Strategy* will depend on municipal initiatives and the cooperation and engagement of citizens, First Nations, developers, industry and other levels of government. Privately owned land represents a majority of the land in Surrey and is where the most significant landscape (i.e. habitat) changes are occurring. Wildlife does not recognize political boundaries

and their habitat ranges cross multiple jurisdictions. The City has some tools to direct conservation efforts to meet biodiversity objectives; however, the success of this Strategy will only be achieved through collaboration with private landowners.

With the importance of stakeholder involvement to the implementation of the *Biodiversity Conservation Strategy*, the project included a significant public consultation component. Public outreach and engagement activities for the *Biodiversity Conservation Strategy* included:

- The establishment of a Stakeholder Working Group made up of key community stakeholders representing a wide variety of organizations, neighbouring governments and other partners;
- The creation of a staff Steering Committee that includes senior staff from key City departments that will be involved in the implementation, monitoring and evaluation of the *Biodiversity Conservation Strategy*;
- Ongoing communications and information sharing activities, including a project website, a project Place-Speak website and regular City of Surrey press releases and updates;
- A public open house and information session to share the draft strategy;
- Presentations to City advisory committees and commissions, including the Environmental Advisory Committee, Development Advisory Committee and Agriculture and Food Security Committee;
- A Corporate Report and presentation to City Council.

An 18-member Stakeholder Working Group was



Oncorhynchus nerka
Spawning Sockeye salmon

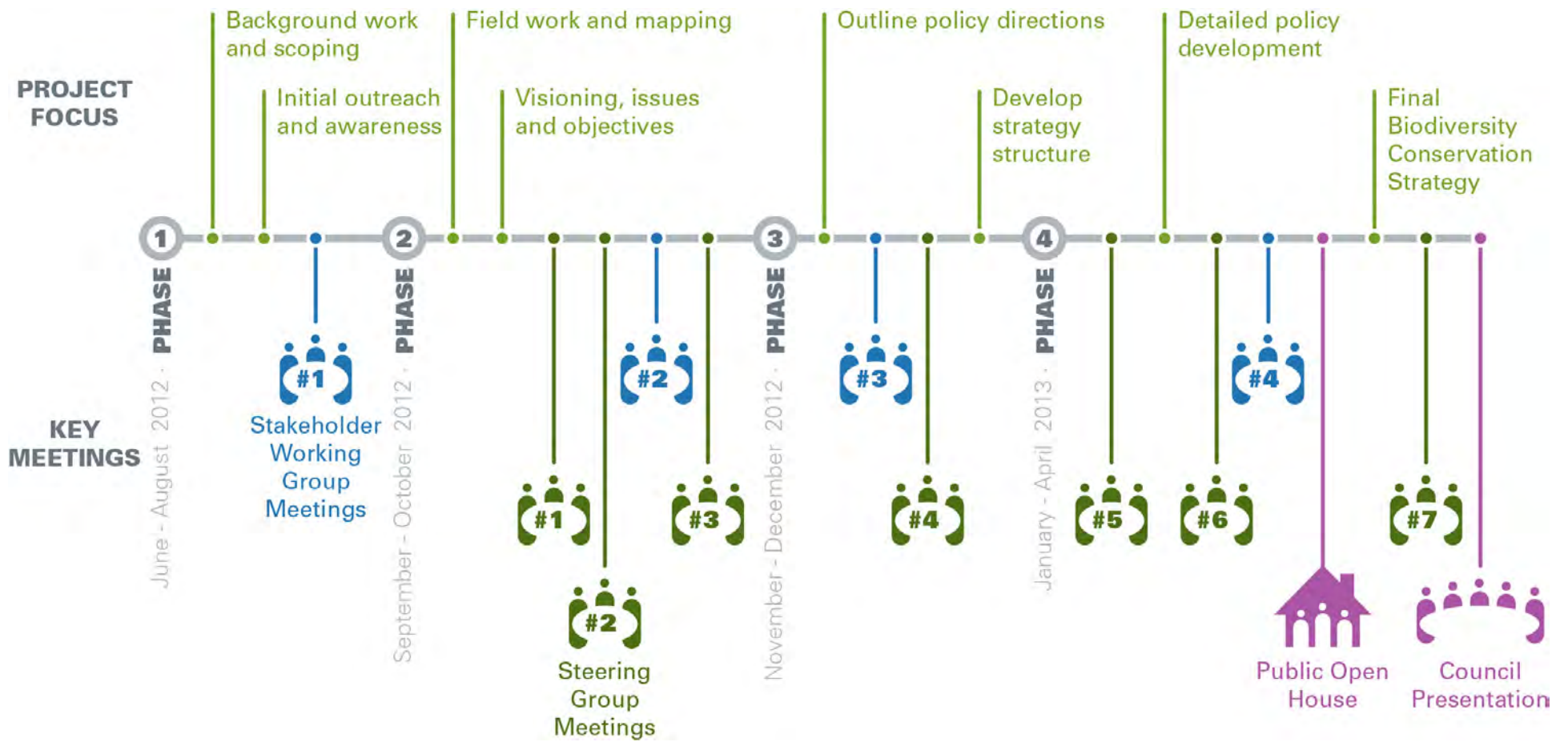


Figure 1: Biodiversity Conservation Strategy Outreach and Engagement Activities

established to ensure that the strategy was developed in a way that is consistent with local values. The Stakeholder Working Group represented a broad cross section of environmental, community, business and development organizations and associations and First Nations. The group met four times throughout the process to provide feedback on data, analysis, findings and final recommendations.

The project Steering Committee was made up of key City of Surrey Staff representing the planning, parks and engineering departments along with the Office of Sustainability. The Steering Committee met seven times over the course of the project to review the content and progress of the BCS.

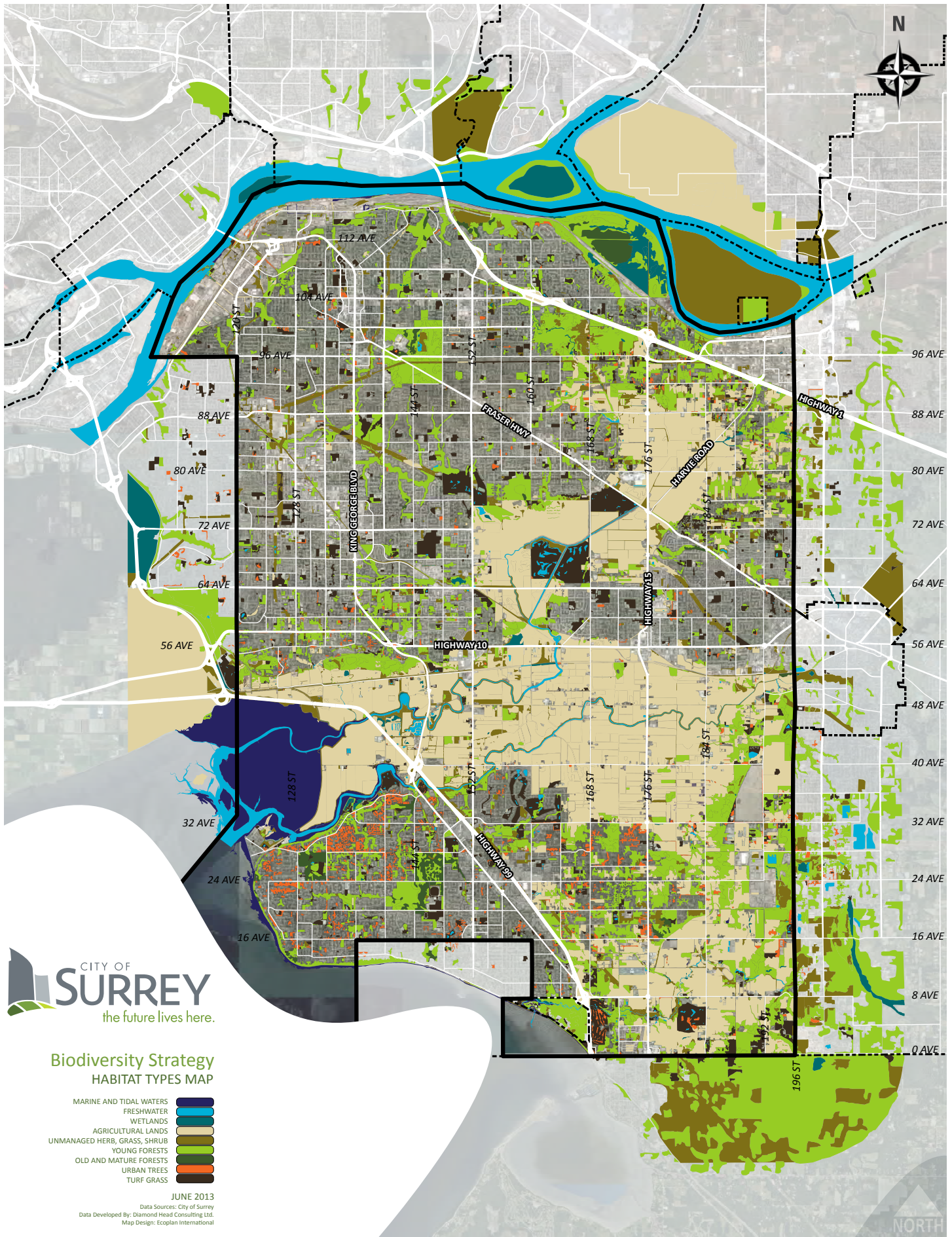
An open house to present the final draft was held at Surrey City Hall on April 30, 2013. Other opportunities to get involved were also provided, including project information on the City of Surrey’s website and a special PlaceSpeak project website that allowed community members to start on-line conversations on different project issues, post pictures and access all project materials. Followers of the City of Surrey on Facebook and Twitter were also notified when new documents and results were posted to both the project website and PlaceSpeak site.

NAME	REPRESENTING
Joanne Charles	Semiahmoo First Nation
Ron Meadley	Semiahmoo Fish and Game Club
Phillip Milligan	Little Campbell Watershed, Semiahmoo Fish and Game Club
Deb Jack	Surrey Environmental Partners
Deana Grinnell	Surrey Development Advisory Committee, Parklane Homes
David Riley	Little Campbell Watershed Society
Al Schulze	Surrey Environmental Advisory Committee, Sunnyside Acres Heritage Society
Erin Clement	Corporation of Delta, Environmental Officer, Climate Action Department
David Riley	Little Campbell Watershed Society
Marg Cuthbert	Friends of Semiahmoo Bay Society
Dan Buffet	Ducks Unlimited Canada
John Werring	David Suzuki Foundation
Peter DeConing	A Rocha Canada
Christie Juteau	A Rocha Canada
Roy Strang	Sunnyside Acres Heritage Society
Lisa Dreves	Langley Environmental Partners Society
Kim Greenwood	Langley Environmental Partners Society
Erin Embley	Metro Vancouver Regional District, Environmental Planner

Table 1: Biodiversity Conservation Strategy Working Group Members

NAME	CITY OF SURREY STAFF POSITION/DEPARTMENT
Don Luymes	Manager of Community Planning
Ted Uhrich	Manager of Parks Planning, Research & Design
Carrie Baron	Manager of Drainage and Environment
Steve Whitton	Manager of Trees & Landscapes
Stephen Godwin	Environmental Coordinator
Markus Kischnick	Community Planning Technician
Greg Ward	Manager of Urban Forestry and Environmental Programs
Doug Merry	Parks Planning Technician
Maggie Baynham	Sustainability Planning Technician
Doug McLeod	Transportation Project Engineer

Table 2: Biodiversity Conservation Strategy Steering Committee



Biodiversity Analysis

Plants (trees, shrubs, herbs, grasses, etc) and wildlife (mammals, birds, fish, amphibians, reptiles, insects, etc) are the most recognized components of biodiversity. Despite their visibility, they represent only a small proportion of the total number of species and biomass (amount of living matter) in nature. Smaller organisms such as fungi, algae, bacteria, and invertebrates comprise most of the diversity in natural ecosystems. However, it is simply not feasible to measure their number and distribution across a large area such as the City. Instead, biodiversity was assessed based on the presence and condition of different habitat types. Species guilds (groups of plants, insects, and animals that share the same habitat) were developed for the City. This was translated into a relative species diversity ranking which was applied to mapped natural areas in Surrey. The value of each habitat area was then modified based on size, connectivity and condition.

Habitat Types

Habitat type mapping is based on work completed for the *Ecosystem Management Study* and Terrestrial Ecosystem Mapping (TEM) data. Mapping linework was updated and refined using the series of orthophotographs taken in 2011. Habitat classification and mapping was confirmed with strategic ground assessments.

Twenty-three general habitat types were identified and mapped in Surrey. These include both natural and developed areas. Although developed areas tend to lack large, contiguous habitat, they do have significant features and functions that support some species. Habitat types fall under one of seven broad habitat classes: forest, streams/lakes, wetlands, marine, shrub/herb/grass, agriculture and urban. These classes are divided further into more specific habitat types. Descriptions of each habitat type are provided in Appendix E.

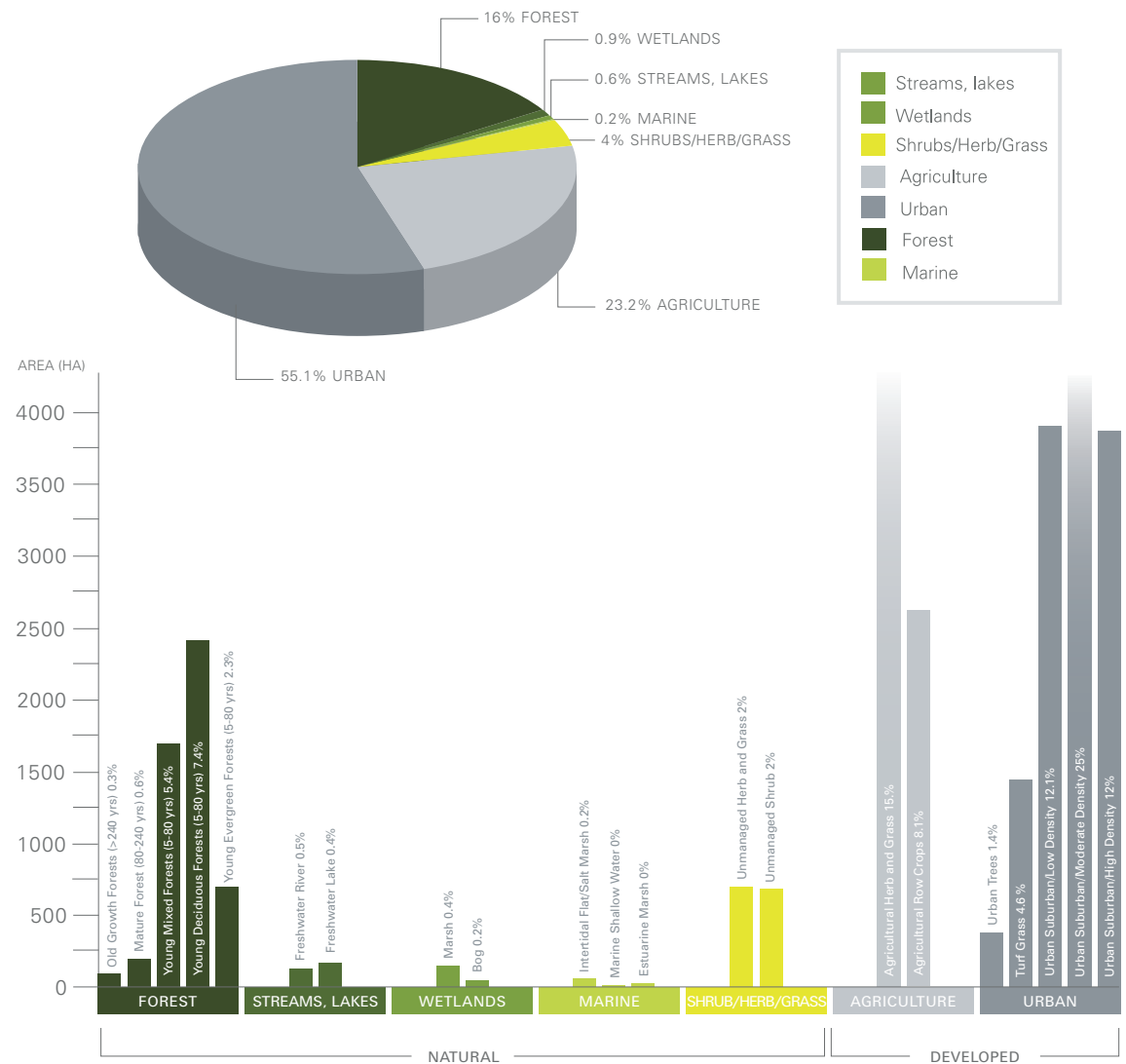


Figure 2 & 3: Habitat types and cover within the City



Varied Thrush Nest

Chinese proverb: "when is the best time to plant a tree? 20 years ago.

The second best time? Today."

Source, "the Man who planted trees"

by Jim Robbins, 2012

HABITAT IN DEVELOPED URBAN AREAS

Developed urban areas contain a diversity of micro-habitats and features (e.g. trees, gardens). Although these micro-habitats are often small and disconnected from one another, they can support a surprising amount of biodiversity including insects and other invertebrates, small mammals, and birds. Commonly, these are smaller species that do not require large, contiguous natural areas. These species tend to be generalists (i.e. use a wide variety of habitats) and are more tolerant of human activity.

Habitat is a broad term that refers to the environment that a species lives in and relies on to carry out its life cycle.

Table 2 shows percent composition of broad cover classes for general OCP land use designations (zones) in developed urban areas. Point sampling was used to quantify habitat types by land use designation. A computer model (i-Tree) placed random sample points across the City which were then classified according to cover type (sampling error +/-3%). Cover classes include tree, lawn, garden/shrub, buildings, hard surface, bare ground and crop.

Generally, the intensity of development will influence the amount of functional habitat that exists. Biodiversity tends to decrease towards the urban core, where there is an increasing density of roads, buildings and infrastructure. Low density residential neighbourhoods typically have more habitat (trees, gardens, natural area) compared to commercial districts and high density neighbourhoods.

*This analysis was performed using the online i-Tree software application. Results are dependent on the age of the images available, and therefore may not represent the most recent state. 300 sample points were taken in each zone, resulting in a standard error of less than 3%.

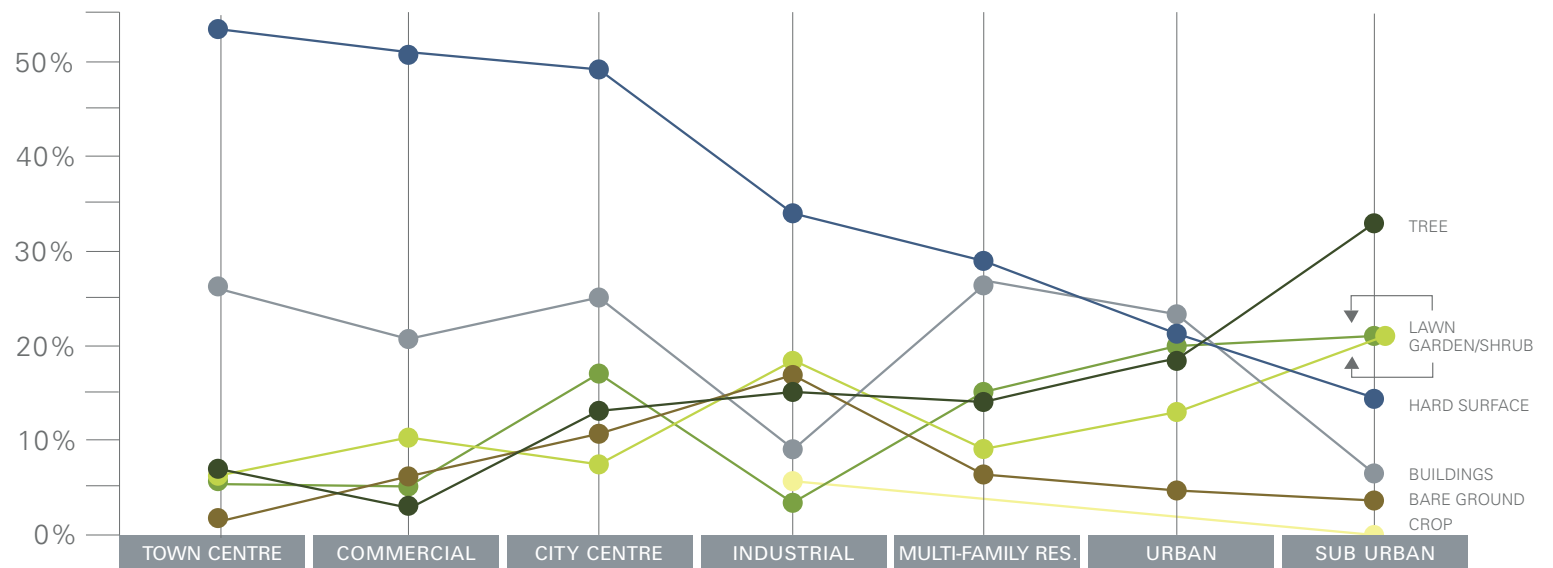


Figure 4: OCP land use designations (zones) in developed urban areas.

SPECIES GUILDS AND SPECIES DIVERSITY

A “species guild” is a biological community consisting of a group of organisms that have similar habitat requirements.

Species guilds were developed to better understand the level of biodiversity associated with habitat types found in Surrey. Guilds include representative species of birds, mammals, amphibians, reptiles, freshwater fish and plants that would have been commonly

associated with each habitat type in an undisturbed state. Subsequently this list includes some species (e.g. grizzly bear) that have been extirpated (no longer locally present) from the region. The list (see Appendix H) was compiled by experienced, local biologists using existing inventories and professional judgment.

Species diversity by habitat is summarized in Table 3. Species are separated into general scientific groups. Relative species diversity for each habitat type is inferred based on the number and percentage of species expected to be present.

HABITAT DESCRIPTION	GROUP					
	Birds (178)*	Mammals (52)*	Amphibians (11)*	Reptiles (6)*	Fish (27)*	Plants (122)*
Young Deciduous Forest	81 (46%)+	41 (79%)	8 (73%)	3 (50%)	N/A	22 (18%)
Young Mixed Forest	82 (46%)	41 (79%)	8 (73%)	3 (50%)	N/A	18 (15%)
Young Evergreen Forest	42 (24%)	33 (63%)	5 (45%)	0 (0%)	N/A	16 (13%)
Mature Forest	49 (28%)	39 (75%)	8 (73%)	3 (50%)	N/A	21 (17%)
Old Growth Forest	46 (26%)	38 (73%)	8 (73%)	3 (50%)	N/A	17 (14%)
Unmanaged Herb and Grass/ Oldfield	69 (39%)	21 (40%)	5 (45%)	3 (50%)	N/A	8 (7%)
Unmanaged Shrub	61 (34%)	22 (42%)	7 (64%)	4 (67%)	N/A	7 (6%)
Intertidal Flat/ Estuarine Marsh	94 (53%)	15 (29%)	0 (0%)	3 (50%)	N/A	9 (7%)
Marsh	87 (49%)	20 (38%)	9 (82%)	5 (83%)	N/A	5 (4%)
Bog	85 (48%)	19 (37%)	8 (73%)	3 (50%)	N/A	7 (6%)
Lake	52 (29%)	12 (23%)	9 (82%)	5 (83%)	21 (78%)	N/A
River	58 (33%)	18 (35%)	9 (82%)	5 (83%)	26 (96%)	N/A
Riparian	86 (48%)	45 (87%)	11 (100%)	6 (100%)	N/A	12 (10%)

Table 3. Species Diversity by Habitat

+ - Example: 46% of the bird species present in Surrey would be expected to be found in young deciduous forest

N/A – Non Applicable

* - Total number of species inventoried



Haliaeetus leucocephalus Bald Eagle





Lophodytes cucullatus Hooded Merganser by Dean O'Dea

Baseline Species Diversity Ranking



Heterotextus alpinus

Species guilds provide a platform for the development of a baseline Species Diversity Ranking. This is a relative indication of species diversity expected to be associated with a particular habitat in an undisturbed state. A ranking between 1 (very low) and 100 (very high) was assigned to each natural habitat type. Rankings were assigned based on species diversity analysis and professional judgment. These rankings reflect natural habitats and do not consider the impacts of human activity, habitat fragmentation, invasive species and other disturbance agents. Professional

“Habitat suitability” refers to the current ecological characteristics of a specific area and its ability to support species.

HABITAT TYPE	SPECIES DIVERSITY RANKING
Old Growth Forests (>240 yrs)	85
Mature Forest (80-240 yrs)	80
Young Mixed Forests (5-80 yrs)	80
Young Deciduous Forests (5-80 yrs)	75
Freshwater River	70
Freshwater Lake	65
Marsh	65
Bog	60
Unmanaged Shrub	55
Young Evergreen Forests (5-80 yrs)	50
Unmanaged Herb, Grass, Old Field	50
Intertidal Flat/Salt Marsh	45
Marine Shallow Water	45
Estuarine Marsh	45
Agricultural Herb and Grass	30
Urban Trees	30
Agricultural Row Crops	30
Turf Grass	10

Table 4. Species Diversity Ranking by Habitat Type

judgment was used to assign baseline species diversity rankings to four developed habitat classes (agricultural herb and grass, agricultural row crops, urban trees and turf grass).

RIPARIAN HABITAT MODIFIER

Riparian habitat is the interface zone that links aquatic and terrestrial ecosystems. Riparian areas support high levels of biodiversity. The City recognizes the importance of riparian areas to protect water quality and to help manage for fish. Protected riparian setbacks are required adjacent to streams and the ocean foreshore. The City classifies watercourses based on fish presence and habitat quality:

- Class A: Inhabited by salmonids year round or potentially inhabited year round.
- Class AO: Inhabited by salmonids primarily during the over-wintering period or potentially inhabited during the over-wintering period with access enhancement.
- Class B: Significant food/nutrient value. No fish present.
- Class C: Insignificant food/nutrient value. No fish present.

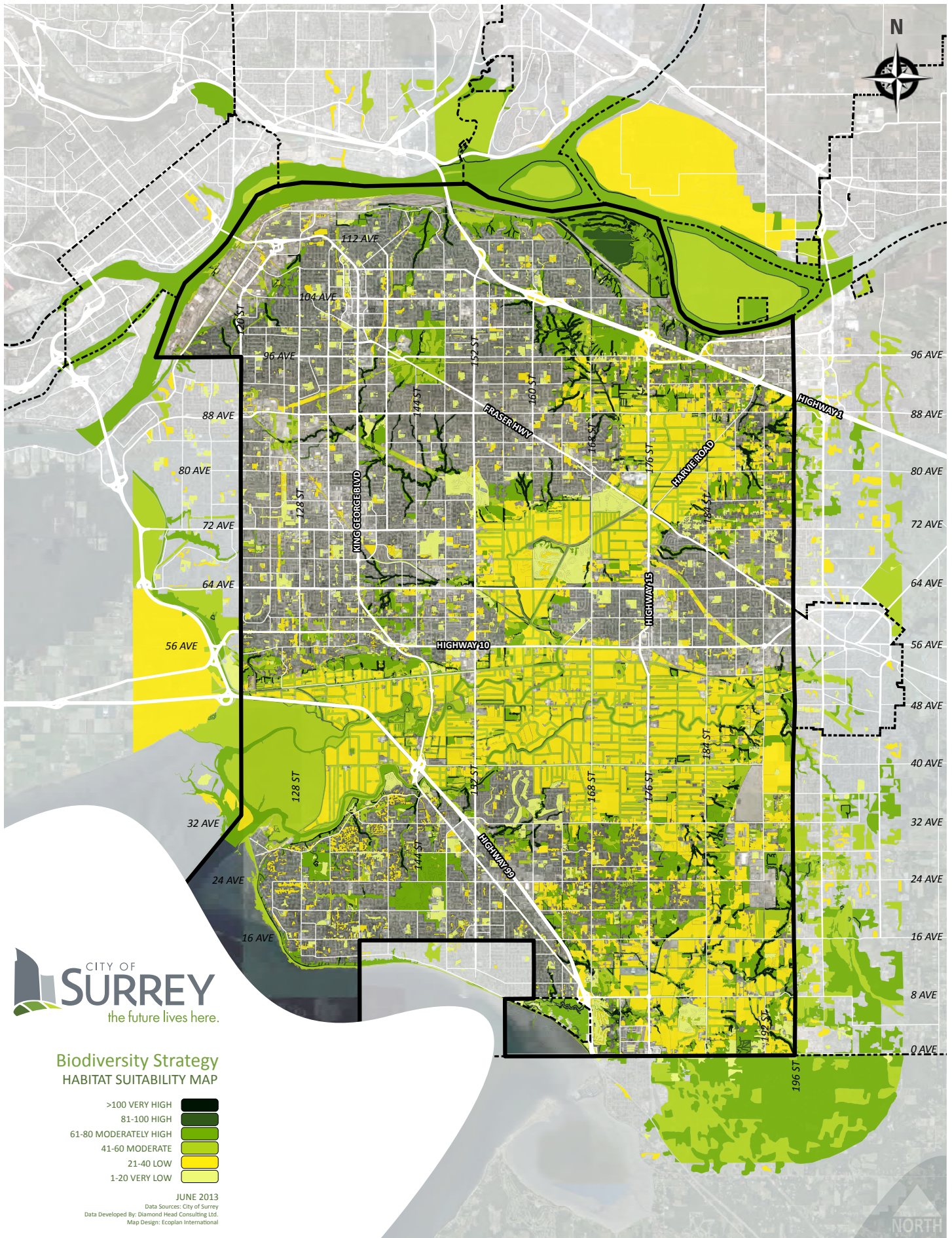
WATERCOURSE CLASSIFICATION	RIPARIAN SETBACK	BIODIVERSITY MODIFIER
Large fish bearing rivers classified A and AO; ponds and lakes	30 m	1.5
Non fish bearing creeks classified B; wetlands	15 m	1.3
Non fish bearing creeks/ditches classified C	5 m	1.1

Table 5. Riparian Habitat Modifiers

Riparian areas within each habitat type were identified. The baseline species diversity ranking in these riparian areas was modified to reflect the influence of riparian habitat (Table 5). The riparian setbacks distances are consistent with the widths defined by the *Provincial Land Development Guidelines of Aquatic Habitat* (DFO 1993). Higher value watercourses have a correspondingly larger modifier.

HABITAT SUITABILITY - THE CURRENT STATE OF BIODIVERSITY

The baseline species diversity ranking is an indicator of potential biodiversity in the City, provided natural areas remain intact and undisturbed. This, of course, does not accurately reflect current conditions. Human activity and landscape fragmentation has drastically altered habitat, which has an enormous effect on biodiversity. “Habitat suitability” refers to the current ecological characteristics of a specific area and its ability to support species. Habitat suitability will vary by species, the species’ life requirements, and the species’ adaptability to changing conditions. Habitat quality, size, connectivity, and disturbance are major factors that affect suitability.



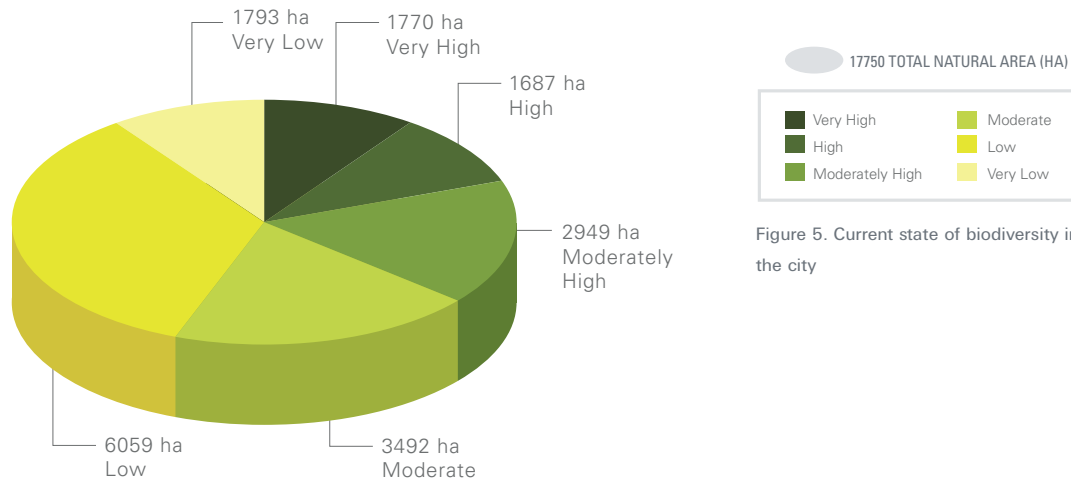


Figure 5. Current state of biodiversity in the city

Habitat suitability was assessed by applying modifiers to the baseline diversity rankings. Modifiers reflect the size and connectivity of habitat areas and are based on the theory of *Island Biogeography* (MacArthur and Wilson, 1967). Larger habitat patches (i.e. islands) generally support greater biodiversity as compared to smaller patches (Cassady et al, 2010).

Natural habitat patches within 30 metres of one another are considered connected and have been grouped together into larger contiguous habitat patches. Roads with four or more lanes were considered a barrier between patches. Suitability modifiers were then applied according to the patch size (Table 6).

An additional connectivity modifier was applied to small patches less than two hectares in size that are further than 100 metres from an adjacent patch greater than two hectares. This reflects the difficulty some terrestrial species have moving between small isolated habitat islands, and the general decline of species diversity in smaller patches due to their inability to repopulate or diversify genetically (MacArthur, R. H. and Wilson, 1967).

Figure 5 shows the current state of biodiversity in the City, illustrating general habitat suitability to support a variety of species in the urban landscape.

ATTRIBUTE	SIZE CATEGORY/AREA	MODIFIER	
Patch Size	Hubs	>200 ha	1.0
		30-200 ha	0.9
		20-30 ha	0.8
		10-20 ha	0.6
	Sites	2-10 ha	0.4
		0-2 ha	0.2
<0.5ha		0.1	
Patch Connectivity	Patches <2ha and further than 100m from any other patches that are >2ha	0.5	

Table 6. Habitat Suitability Modifiers

SUITABILITY RANKING	CLASS	TOTAL HABITAT AREA (HA)
>100	Very High	1770
>80	High	1687
61-80	Moderately High	2949
41-60	Moderate	3492
21-40	Low	6059
1-20	Very Low	1793

Table 7. Habitat Suitability



Chamerion angustifolium
Fireweed

Managing for Biodiversity

Effective management of biodiversity requires planning at both the regional and the local level. At the regional level, the Green Infrastructure Network (GIN) will form the backbone of this *Biodiversity Conservation Strategy*. Habitat connectivity is vital to ensuring that all species are able to meet their life requirements and maintain genetic diversity in the population. After the GIN is established, a majority of land in Surrey will fall outside its boundaries on private land. This large, non-protected area also supports a diversity of habitats and species that contribute significantly to overall biodiversity. Broad management strategies and conservation targets supporting the GIN and biodiversity in non-protected areas are provided.

Local (site) level planning introduces specific strategies and recommendations to improve the ability of a natural area to support a diversity of species. Strategies tend to focus on localized efforts to improve ecological integrity, whether that is through site design, development criteria, or habitat restoration and enhancement. Whereas habitat suitability refers to the current ability of an area to support biodiversity, habitat capability refers to an area's potential to support certain species if ecological conditions are improved. Enhancing biodiversity from the current state will be challenging as urban development continues. This Strategy identifies the best opportunities to protect and enhance habitat to manage for biodiversity while recognizing planned future growth.

Adopting the concept of the GIN allows the City to prioritize efforts for conservation and enhancement and provides some certainty for land use planning. Implementation of the GIN should consider the following:

1. Strategic planning: Conservation initiatives (e.g. land acquisition) should focus on developing and enhancing the GIN and highly ranked habitat areas. This will ensure that City resources are used in the most cost-efficient and beneficial manner.

2. Quality versus quantity: If biodiversity is considered strictly in terms of the amount of habitat (area) that exists, then there is the risk of losing rare high quality habitat and their associated species. A smaller amount of diverse and well-connected habitat can support a higher diversity of species as opposed to larger areas of homogeneous and disconnected habitat.

3. Multiple values: Greater support from government, citizens, developers and industry can be achieved by linking biodiversity conservation to other community values (e.g. food security, recreation, stormwater management, clean air).



Highway 15

Neotamias amoenus Yellow Pine Chipmunk



Key Biodiversity Conservation Principles

Fundamental principles of biodiversity conservation should be followed at both the landscape and site level. These include:

1. Protect critical habitat and features:

A diversity of habitat types and features is necessary to support the rich variety of species (migratory and resident) in Surrey, particularly those that are at risk, threatened or endangered.

2. Enhance habitat connectivity: Establishing natural corridors between fragmented patches results in more habitat connectivity, facilitates species movement, and promotes genetic dispersal.

3. Maximize the size of core natural areas: In general, larger habitat areas support a greater diversity and number of species. Areas with more interior forest provide more secure protection and cover for species that are less tolerant of disturbance.

4. Improve habitat quality: Habitat degradation and disturbance resulting from development, pollution, invasive species introduction, noise, light, off-leash dogs, etc. reduce suitability to support a diversity of species.

5. Research: Wildlife and vegetation inventories, ecological assessments, and monitoring programs are important to increase our understanding and better inform management decisions.

6. Education and public awareness: Increasing awareness of biodiversity and its values in the urban environment is critical to support biodiversity conservation initiatives.

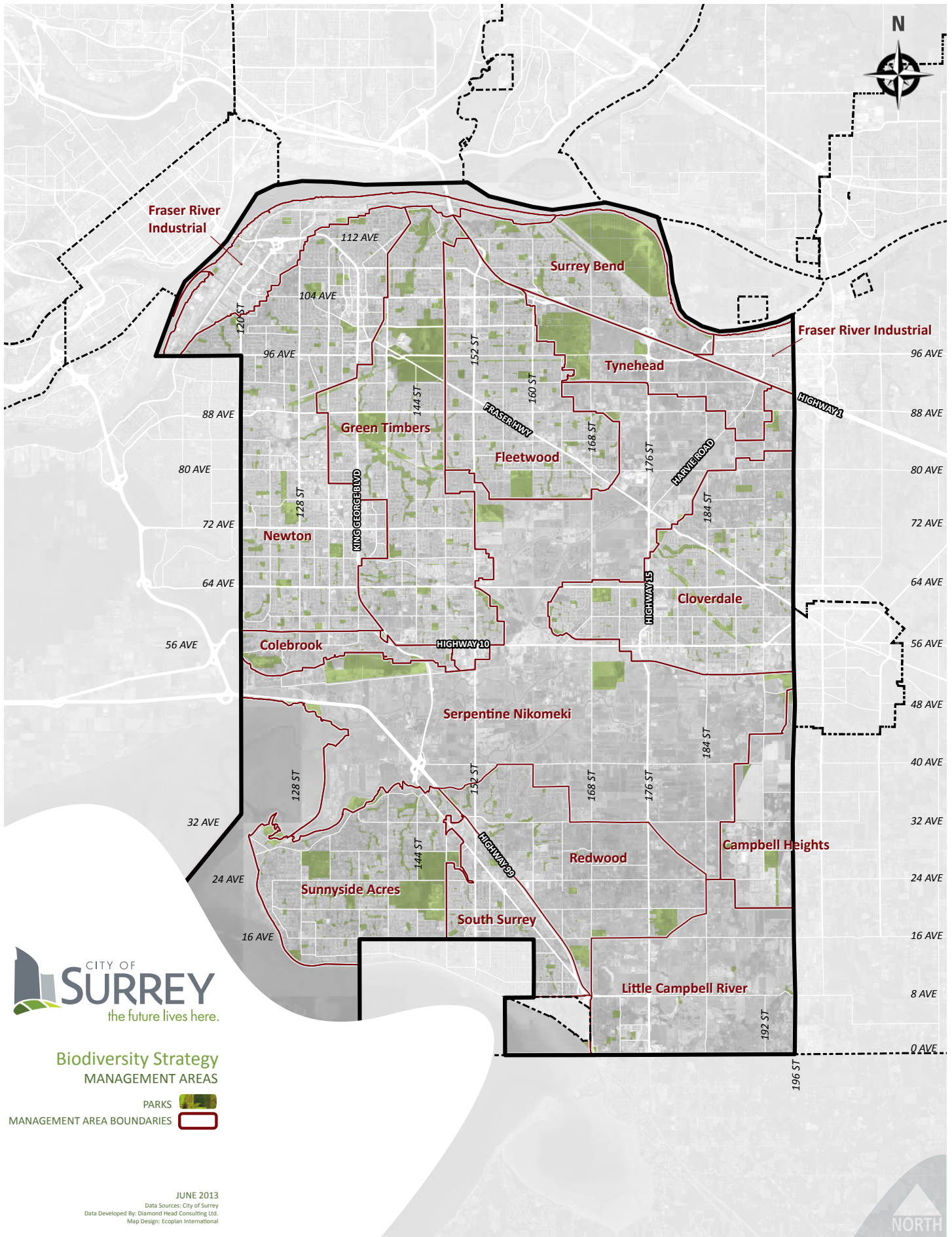
7. Regulations: City policies and strategies that support biodiversity conservation are best implemented through public education and awareness combined with an enforced regulatory framework. Policies should be sensible and straightforward, establish expectations, and provide a high level of certainty for landowners and developers. Biodiversity related policies with no regulatory enforcement are less likely to be implemented.

8. Community action: Community stakeholder groups are instrumental in supporting and implementing biodiversity conservation initiatives. Voluntary action to support biodiversity on private property is also crucial.

9. Ecosystem Services: By conserving biodiversity, we can meet multiple objectives for human health such as stormwater management, climate change, improving air and water quality.



Serpentine River



Biodiversity Management Areas

Effective management of biodiversity requires a realistic appraisal of the urban environment and its influence on habitat and species. Intensive land use, human disturbance, population growth and other factors mean that is not possible to manage for all species in all parts of the City. Some species with specific habitat requirements simply cannot be sustained over the long-term. It is also important to recognize that there are both benefits and challenges to maintaining biodiversity. Trying to support certain species within an urban setting can result in undesirable conflicts.

Recognizing Surrey’s large size, diversity of land use and ecological features, the City has been divided into smaller, more homogenous Management Areas. Five broad Management Classes, sub-divided into 14 Biodiversity Management Areas, are designated. Each Management Area has unique conditions (e.g. biophysical, geographic, climatic, land use) that influence biodiversity. Defining these areas creates space for specific opportunities and strategies to be recommended in the City.

Agricultural - Agricultural areas (both in and out of the ALR) have extensive open managed grassland and shrub habitat with fragmented forested patches. There are generally fewer barriers to movement compared to urban environments. This area includes lowland floodplain that provides critical habitat for birds, including a large number of Surrey’s wetlands. Three productive river systems, including some of their main tributaries, flow through the agricultural area.

Industrial - Industrial lands have been significantly modified. Some remnant forest stands do remain in the south; however, most land has been developed to support large buildings and related infrastructure. Areas adjacent to the Fraser River have little natural habitat. Micro-habitat exists along ditches, landscaped areas, and underused or abandoned property. Species present are generally smaller wildlife that can adapt to niche habitats and those that are more tolerant of human disturbance.

Suburban South - These areas have a relatively intact network of protected and undeveloped forest land. Some remnant stands are of significant size. Coastal habitat includes saltwater

marshes, intertidal flats and dune ecosystems. Development is typically lower density residential. There is opportunity to establish a more functional GIN that can support a high diversity of species, many of which are less tolerant of urban development.

Suburban North - These areas contain remnant patches of upland forest. Development is typically low to medium density residential. Larger forest patches contain functional core habitat; however, there is limited connectivity to adjacent natural areas. Fish bearing watercourses with intact forested riparian corridors also occur. Existing habitat generally supports smaller wildlife species, many of which are adapted to urban environments or are more tolerant of disturbance.

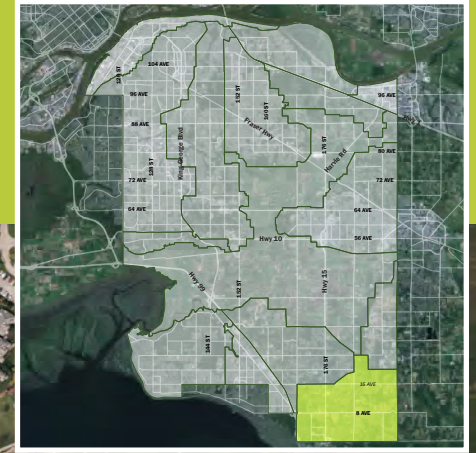
Urban - Urban areas are typified by higher density residential and commercial development. Natural habitat is largely absent, except for small, fragmented patches. Landscaped areas, gardens, backyards, street trees and other micro-habitats support a variety of urban adapted species.

A snapshot of existing ecological conditions and degree of habitat protection for each Management area is highlighted in the following tables. Management objectives are provided for each Management Area with corresponding opportunities and constraints.

CLASS	MANAGEMENT AREA
Agricultural	Little Campbell River, Serpentine/Nikomekl
Industrial	Fraser River Industrial, Campbell Heights
Suburban South	Sunnyside Acres, Redwood
Suburban North	Colebrook, Green Timbers, Surrey Bend, Tynehead
Urban	Cloverdale, Newton, Fleetwood, South Surrey

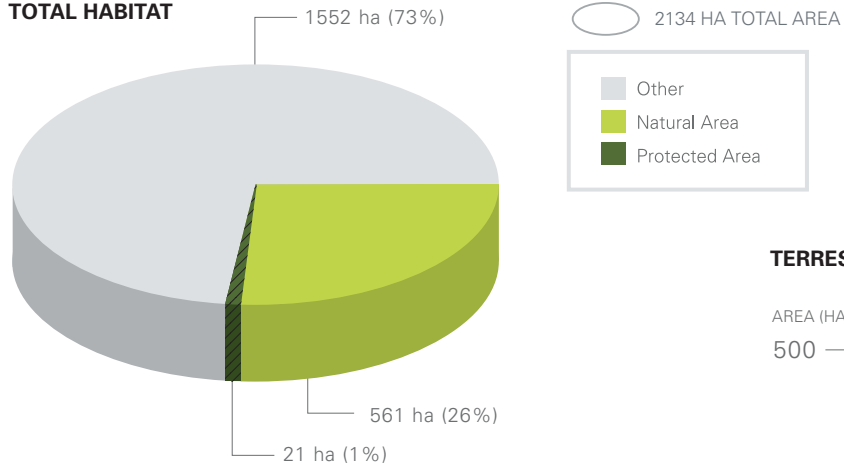
Table 8 Management Areas

Little Campbell River Management Area

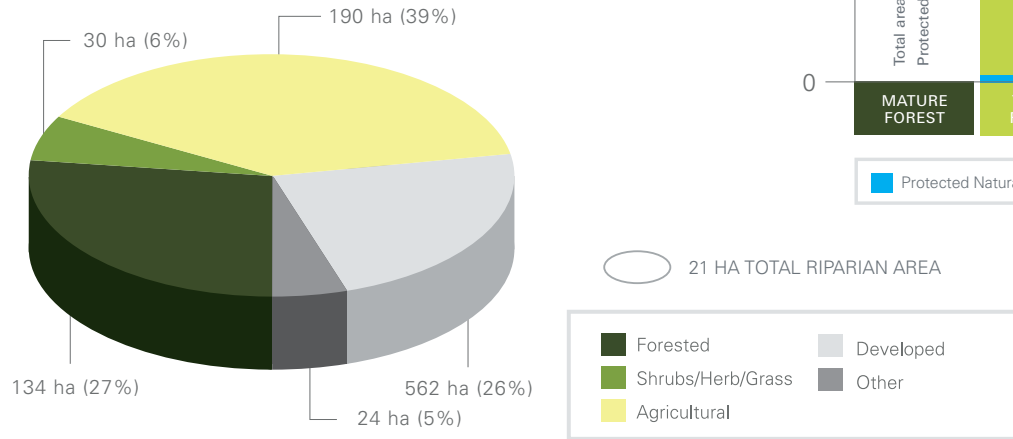


Lowland areas encompassing the lower reaches of the Little Campbell River and its tributaries

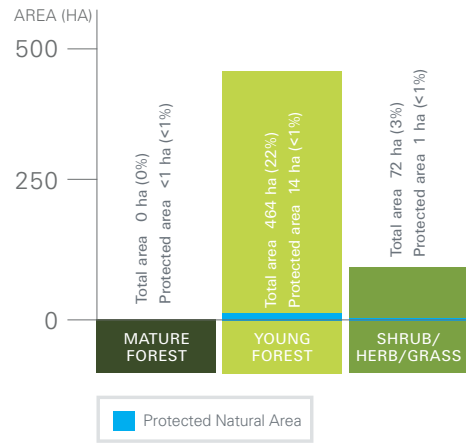
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Protect and enhance riparian habitat along the Little Campbell River and its tributaries to support fish and wildlife, and protect and improve water quality;
- Promote sustainable agricultural practices and development on ALR land to support biodiversity (e.g. wetland preservation);
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Maintain large rural lot sizes;
- Remove fencing and promote secure movement corridors for large mammals;
- Work with agricultural landholders to maintain migratory bird habitat;
- Increase the cover of forested habitat;
- Increase forest and shrub cover in riparian areas of streams, wetlands and ponds.

OPPORTUNITIES

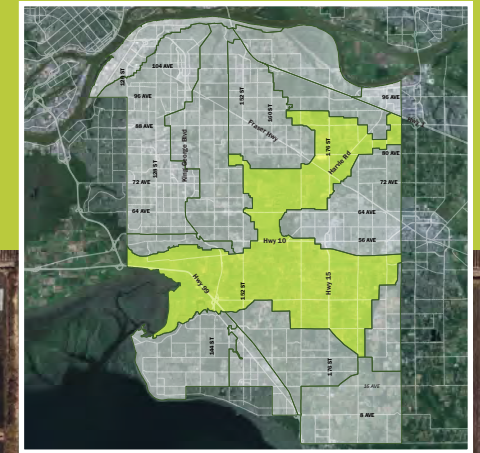
- Natural non-dyked riparian areas can be enhanced adjacent to the Little Campbell River system;
- Large forest patches in Langley and Washington provide contiguous high values habitat areas;
- Golf courses could be naturalized;
- Abundant area of non developed land;
- High number of functioning fish bearing creeks;
- Most disturbed riparian areas are not developed and could be enhanced.
- Farm BMPs (Beneficial Management Practices) and Environmental Farm Plans

CONSTRAINTS

- Limited planning/management authority on ALR;
- Major transportation corridors (Pacific Highway, 99)

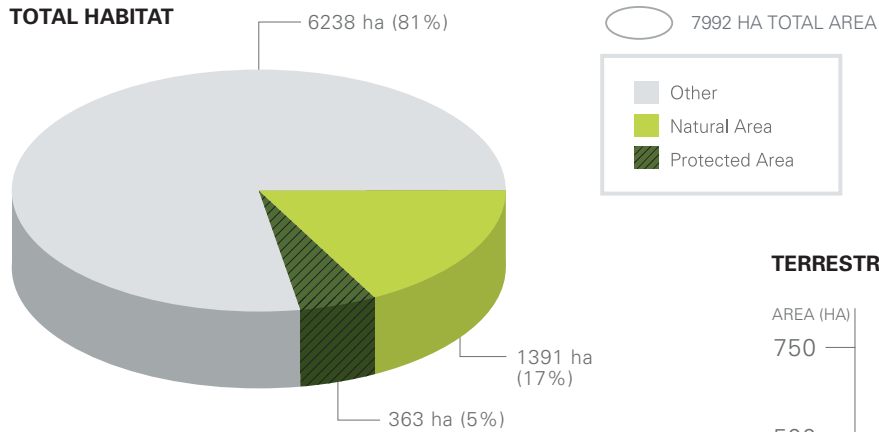
LITTLE CAMPBELL RIVER					
Total Area		Natural Area		Protected Area	
2134 ha		561 ha (25%)		21 ha (1%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
0 ha (0%)	<1 ha (<1%)	464 ha (22%)	14 ha (<1%)	72 ha (3%)	1 ha (<1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
59.7 km		51.1 km		15	41
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
490 ha	134 ha (27%)	30 ha (6%)	190 ha (39%)	112 ha (23%)	

Serpentine – Nicomekl River Management Area

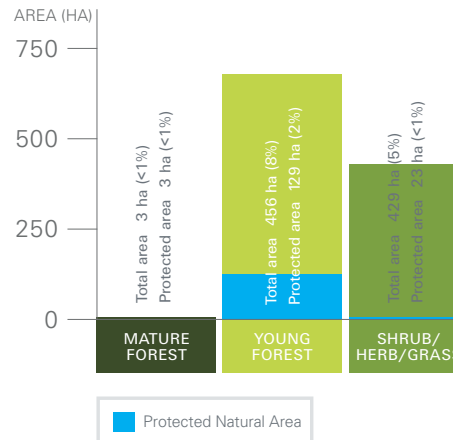


Lowland areas on ALR encompassing the Serpentine and Nicomekl Rivers

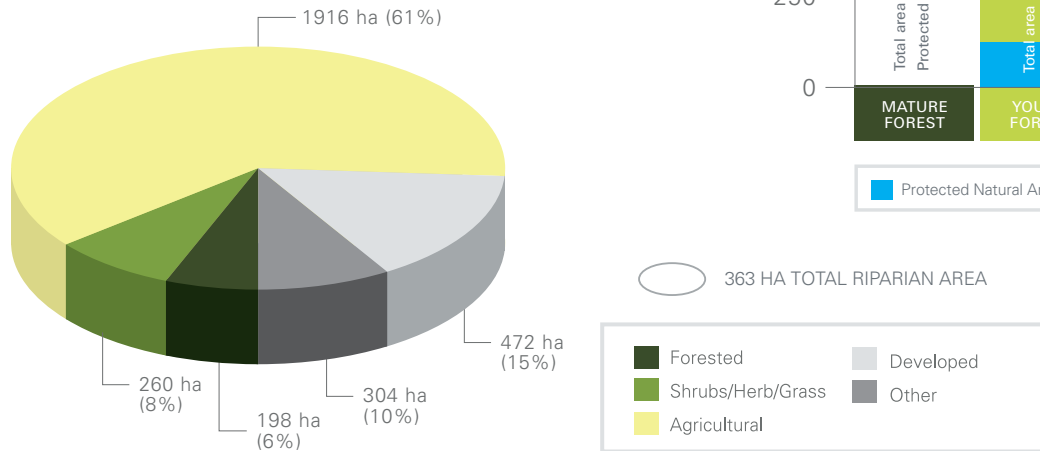
TOTAL HABITAT



TERRESTRIAL HABITAT



RIPARIAN HABITAT



MANAGEMENT OBJECTIVES

- Protect and enhance riparian habitat along the Nicomekl and Serpentine Rivers and their tributaries to support fish and wildlife, and protect water quality;
- Enhance foreshore and estuarine habitat along Mud Bay;
- Promote sustainable agricultural practices and development on ALR land to support biodiversity (e.g. wetland preservation);
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Maintain large rural lot sizes;
- Remove fencing and promote secure movement corridors for large mammals;
- Work with agricultural landholders to maintain migratory bird habitat;
- Increase the cover of forested habitat;
- Increase forest and shrub cover in riparian area;
- Preserve and establish forested areas next to the ALR to act as habitat corridors and buffers to agricultural activity.

OPPORTUNITIES:

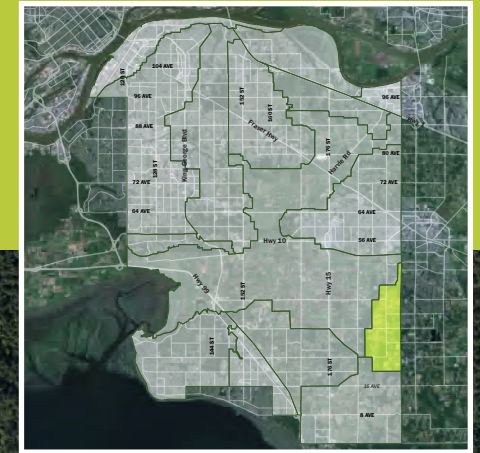
- Highest concentration of wetlands and ponds in Surrey;
- High number of fish bearing creeks;
- Abundant area of non developed land;
- Remnant patches of non-arable forested land;
- Several golf courses located adjacent to watercourses and corridors.

CONSTRAINTS:

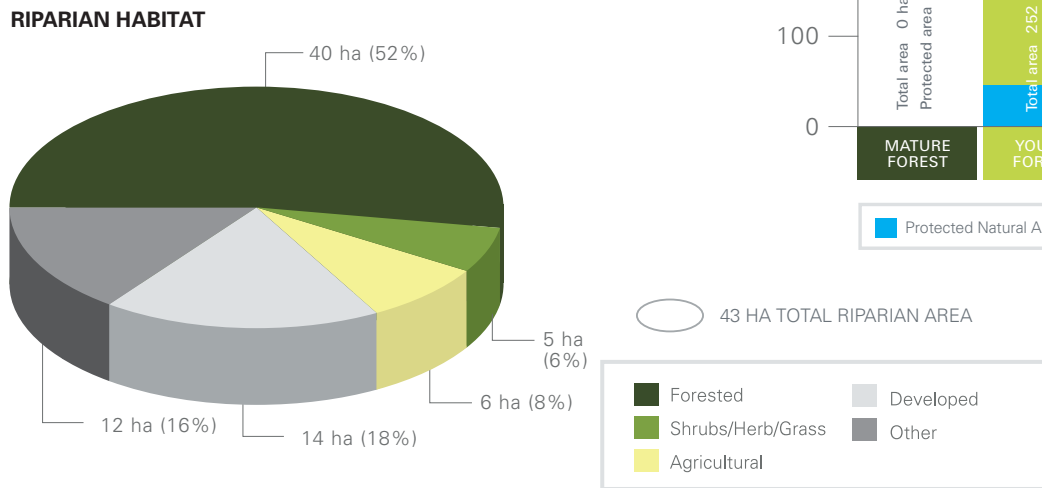
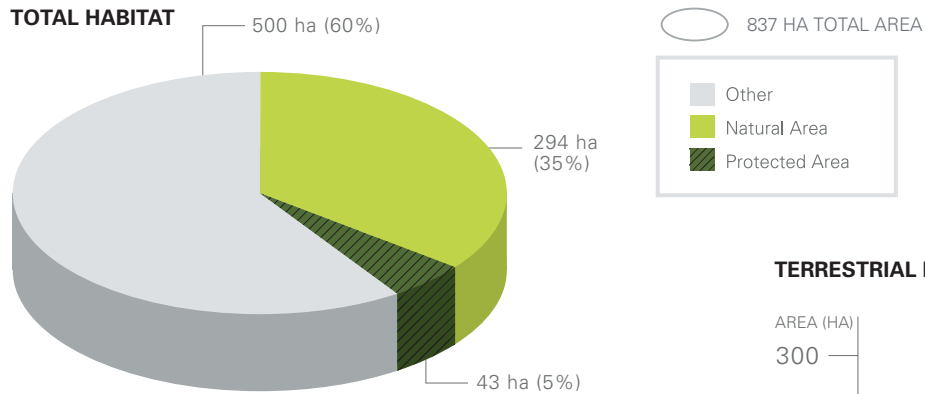
- Limited planning/management authority on ALR;
- Major transportation corridors (Hwy 99, 10, 15, Fraser Hwy and King George Blvd.);
- Primary river systems are dyked for flood control;
- Most riparian area has been cleared for agriculture;
- Rivers inhibit movement of some terrestrial species.

SERPENTINE – NICOMEKL RIVER					
Total Area		Natural Area		Protected Area	
7992 ha		1391 ha (17%)		363 ha (5%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
3 ha (<1%)	3 ha (<1%)	656 ha (8%)	129 ha (2%)	429 ha (5%)	23 ha (<1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
585.4 km		32.9 km		58	124
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
3150 ha	198 ha (6%)	260 ha (8%)	1916 ha (61%)	472 ha (15%)	

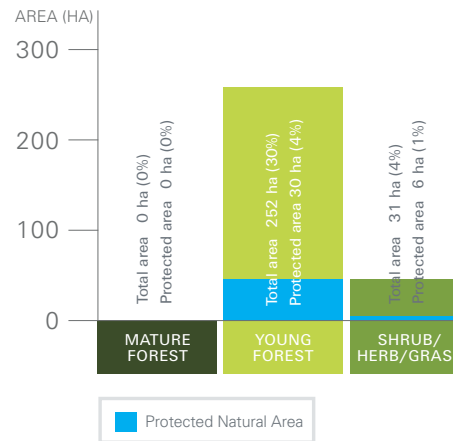
Campbell Heights Management Area



Industrial zoned lands in the Little Campbell River watershed of southeast Surrey



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Protect and enhance streams and riparian habitat on the Little Campbell River and tributaries;
- Provide functional movement from the ALR to the natural areas of Langley;
- Increase tree cover;
- Develop incentives to incorporate green building features on industrial land and buildings to enhance biodiversity;
- Protect remaining forested areas along the western boundary adjacent to the escarpment in the ALR.

OPPORTUNITIES

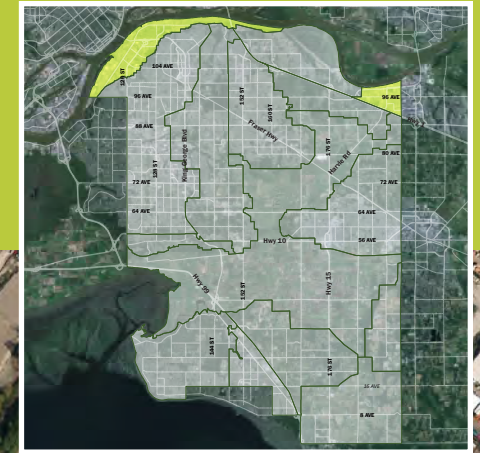
- Remnant forests in large patches on east and west boundaries;
- Old gravel pit provides opportunity for restoration;
- Large lot sizes provide flexibility to incorporate green design and retain/restore natural features;
- Large areas of forested habitat have not yet been developed.

CONSTRAINTS

- Large scale industrial development currently in progress;
- Much of remaining forested land slated for development.

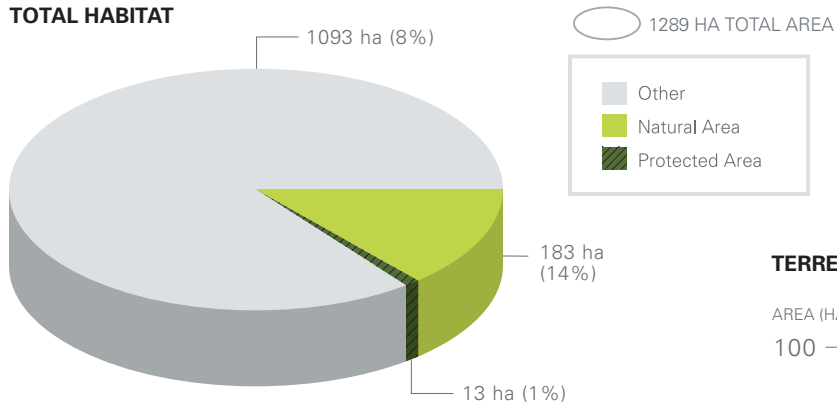
CAMPBELL HEIGHTS					
Total Area		Natural Area		Protected Area	
837 ha		294 ha (35%)		43 ha (5%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
0 ha (0%)	0 ha(0%)	252 ha (30%)	30 ha (4%)	31 ha (4%)	6 ha (1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
7.8 km		7.8 km		3	7
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
77 ha	40 ha (52%)	5 ha (6%)	6 (8%)	14 (18%)	

Fraser River Industrial Management Area

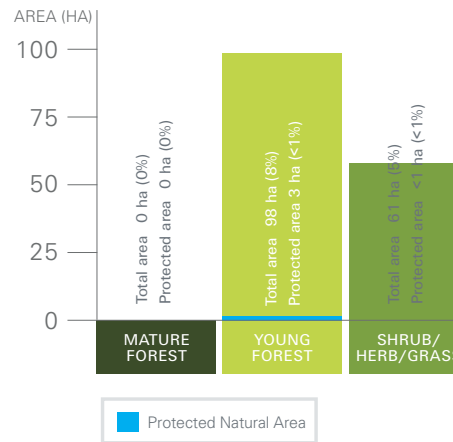


North Surrey along Fraser River

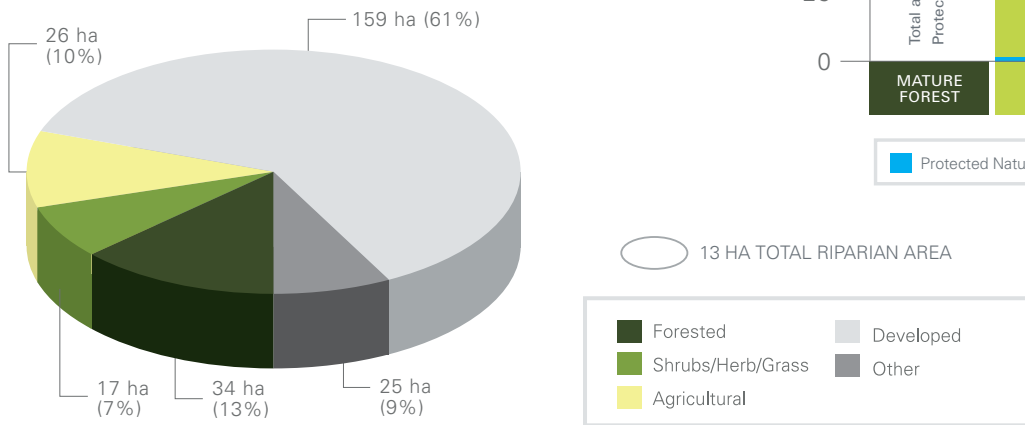
TOTAL HABITAT



TERRESTRIAL HABITAT



RIPARIAN HABITAT



MANAGEMENT OBJECTIVES

- Protect remaining natural habitat in lowland areas;
- Establish riparian buffer along Fraser River to support wildlife movement and regional trail development;
- Enhance lowland riparian areas to improve fish habitat and water quality;
- Develop incentives to incorporate green building features on industrial land and buildings to enhance biodiversity;
- Increase amount of natural and semi-natural habitat on public and private lands through restoration and redevelopment;
- Increase total tree cover on natural and developed areas.

OPPORTUNITIES

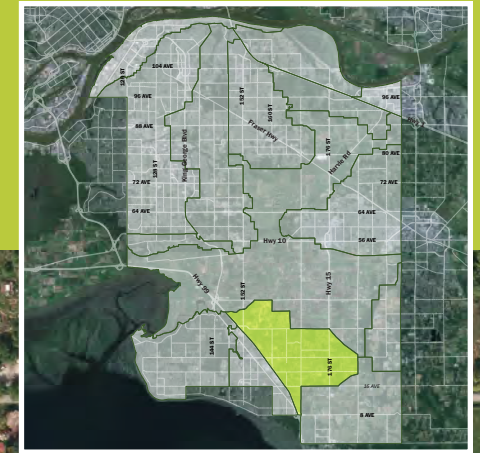
- Regional initiative to develop trail/greenway (Experience the Fraser);
- Fish-bearing creeks connecting to the Fraser River;
- Numerous fish bearing ditches that could be enhanced;
- Ravines along escarpment provide connectivity from upland to lowland areas.

CONSTRAINTS

- Few remaining natural areas;
- Many watercourses are confined to constructed ditches;
- Industrial zone with few permeable surfaces;
- Major transportation corridors (South Fraser Perimeter Road, Golden Ears Way, Trans-Canada Highway, Railway).

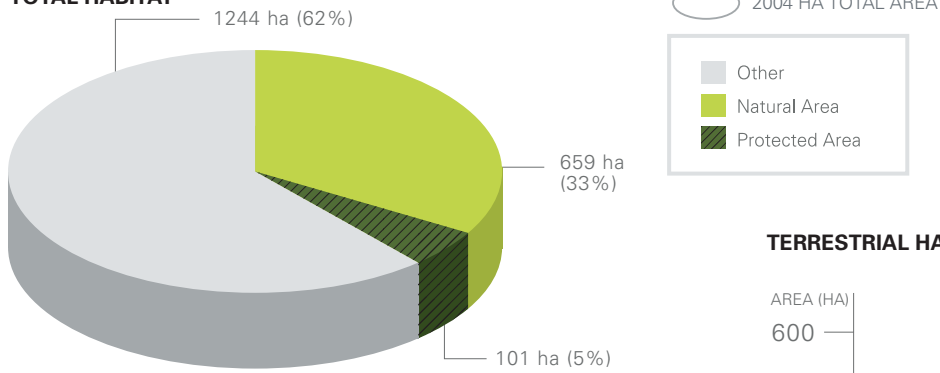
FRASER RIVER INDUSTRIAL					
Total Area		Natural Area		Protected Area	
1289 ha		183 ha (14%)		13 ha (1%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
0 (0%)	0 (0%)	98 (8%)	3 (<1%)	61 (5%)	<1 (<1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
28.6 km		14.8 km		29	14
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
261 ha	34 ha (13%)	17 ha (7%)	26 ha (10%)	159 ha (61%)	

Redwood Management Area

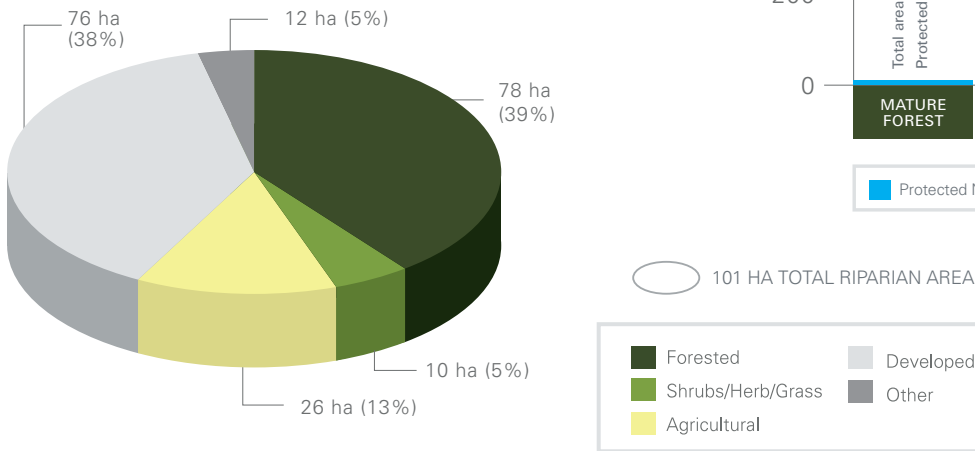


South Surrey east of Highway 99

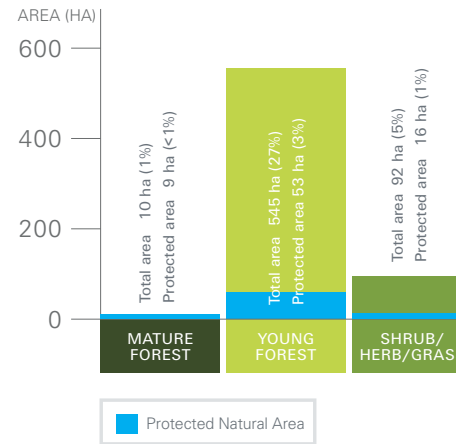
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Improve habitat connectivity between major hubs/natural areas to support movement of large mammals;
- Work with landholders to maintain and enhance natural habitat on private lots;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Retain large lot sizes where existing zoning permits;
- Protect and enhance riparian habitat associated with Nicomekl River;
- Protect and enhance existing ponds and wetlands;
- Increase tree cover adjacent to the ALR;
- Increase the number of wetlands.

OPPORTUNITIES

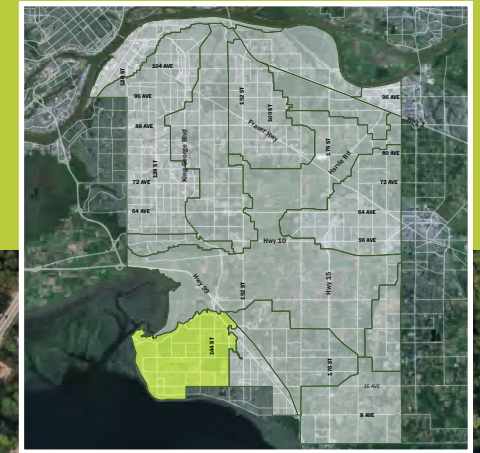
- High proportion of remnant forest in several large patches;
- Functioning corridors for large mammals;
- Edge forest habitat adjacent to ALR;
- Naturalization of golf courses;
- Larger lots abutting existing corridors and natural areas.

CONSTRAINTS

- Approved land use plans for urban neighborhood in place or in process;
- Commercial development on west side;
- Major transportation corridors (Hwy 99, Pacific Highway).

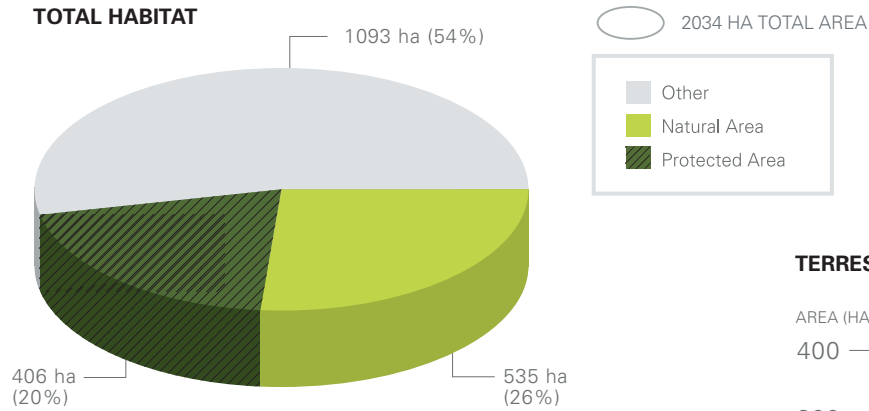
REDWOOD					
Total Area		Natural Area		Protected Area	
2004 ha		659 ha (33%)		101 ha (5%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
10 (1%)	9 (<1%)	545 (27%)	53 (3%)	92 (5%)	16 (1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
13.3 km		23.2 km		3	30
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
202 ha	78 ha (39%)	10 ha (5%)	26 ha (13%)	76 ha (38%)	

Sunnyside Acres Management Area

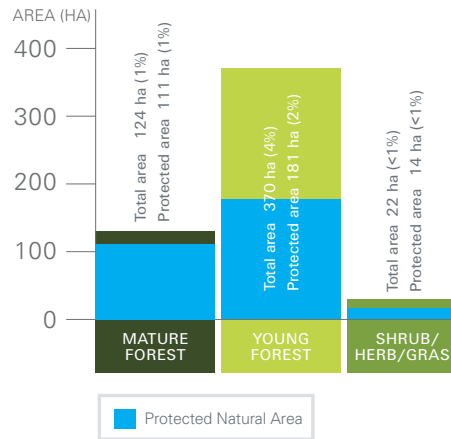


Uplands west of Highway 99, surrounding City of White Rock and bounded by Semiahmoo, Boundary Bay, and Nicomekl River.

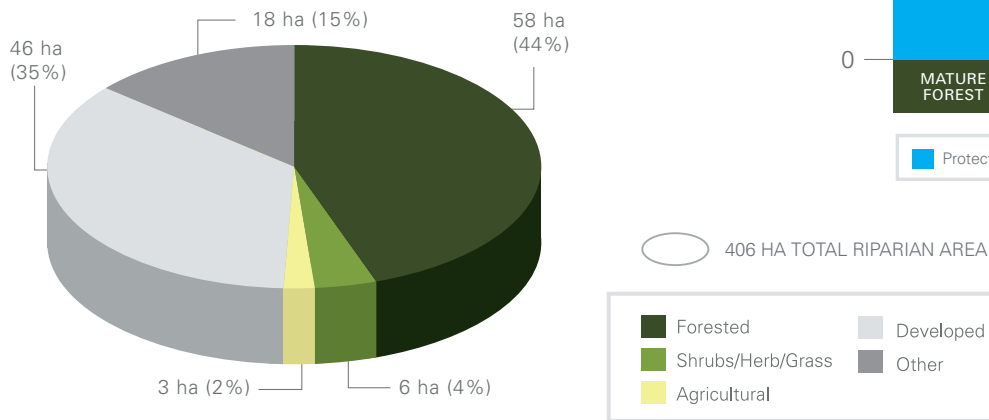
TOTAL HABITAT



TERRESTRIAL HABITAT



RIPARIAN HABITAT



MANAGEMENT OBJECTIVES

- Maintain and enhance natural habitat on large residential lots;
- Improve habitat connectivity to support movement of large mammals (e.g. deer);
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Work with land owners to naturalize yards adjacent to the GIN;
- Protect and enhance marine and riparian habitat in Mud Bay/Nicomekl River interface;
- Increase the number of wetlands.

OPPORTUNITIES

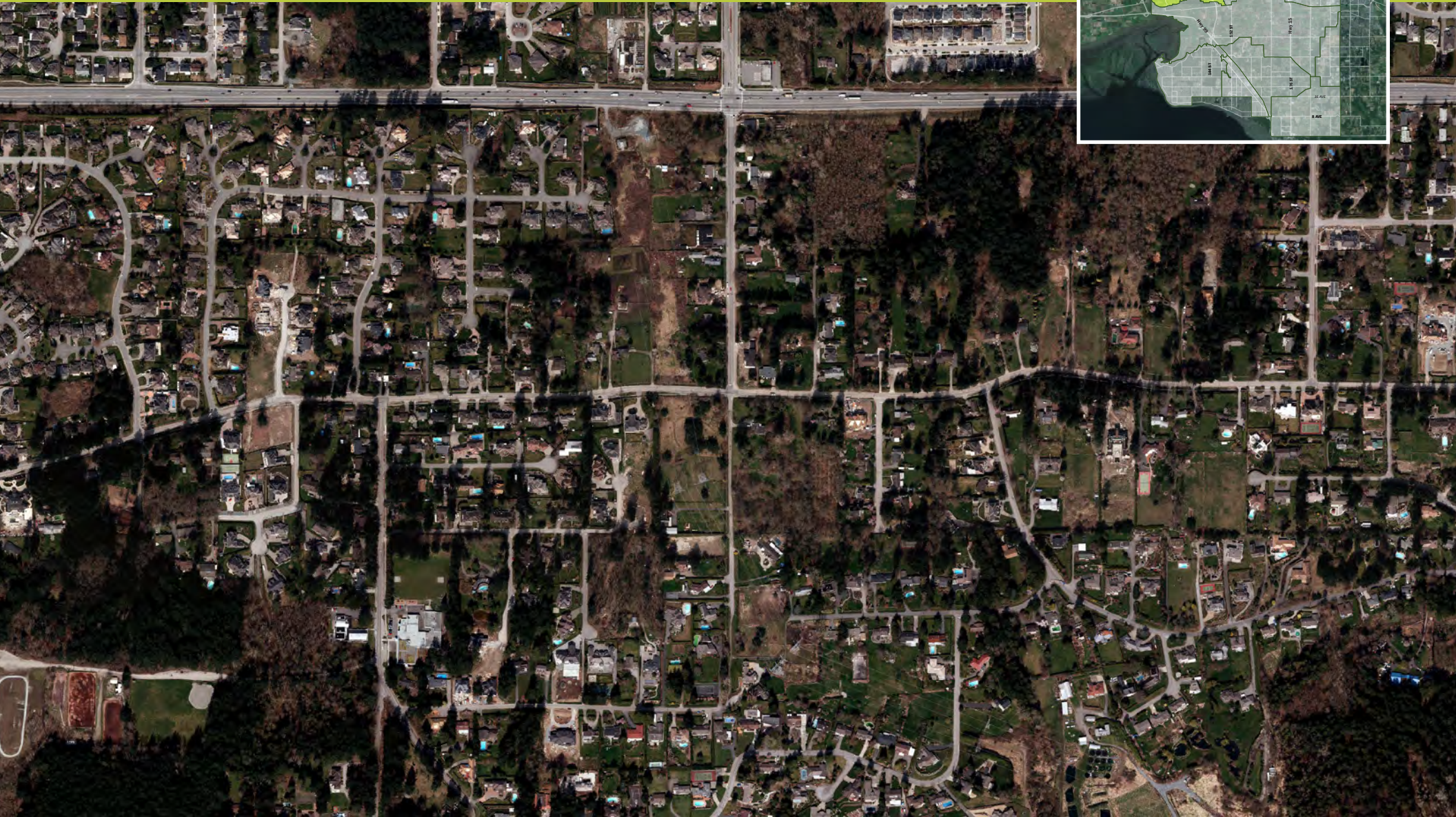
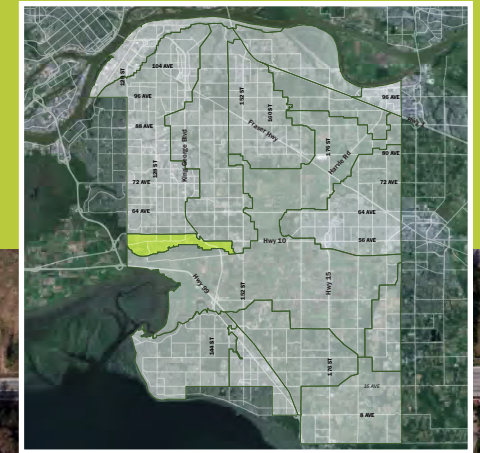
- Contains largest area of the Biogeoclimatic Ecosystem Classification system CDFmm subzone which includes red- and blue-listed plant communities;
- Preserve and enhance ecological integrity of large natural hubs;
- Largest natural areas already protected as parkland;
- Many identified corridors protected as parks;
- Large marine interface, undeveloped foreshore and bluffs;
- High value interface with Nicomekl River and intertidal habitat;
- Larger lots with significant natural habitat;
- Numerous large mature coniferous trees in natural and developed areas.

CONSTRAINTS

- Built-out with few re-development opportunities;
- High land values and established estate lots;
- Major transportation corridors (Hwy 99, King George Blvd) to northeast.

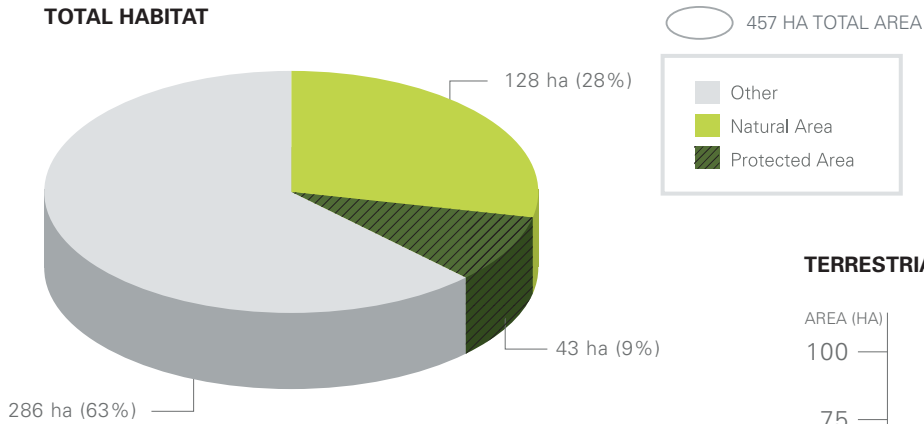
SUNNYSIDE ACRES					
Total Area		Natural Area		Protected Area	
2034 ha		535 ha (26%)		406 ha (20%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
124 (1%)	111 (1%)	370 (4%)	181 (2%)	22 (<1%)	14 (<1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
13.5 km		7.4 km		7	14
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
131 ha	58 ha (44%)	6 ha (4%)	3 ha (2%)	46 ha (35%)	

Colebrook Management Area

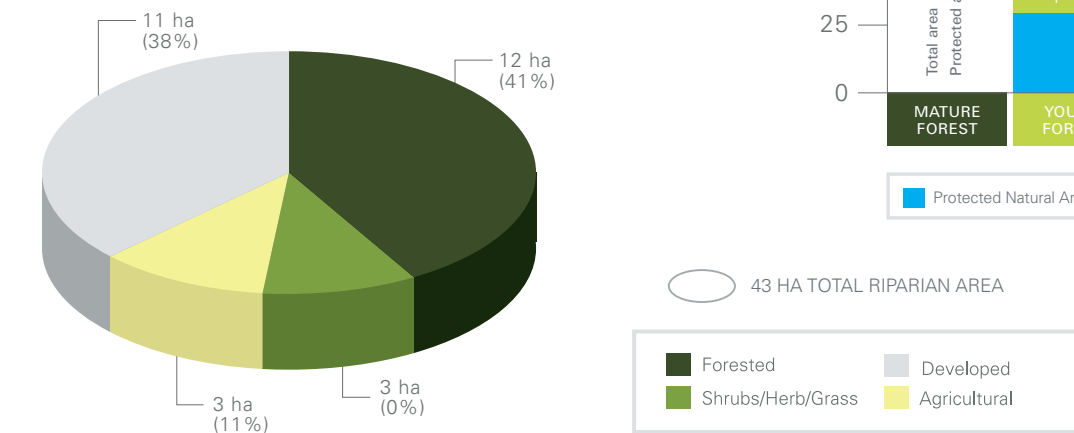


Upland area and south facing slopes located between ALR and Highway 10

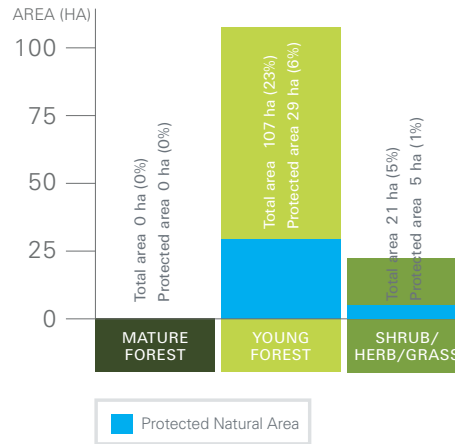
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Work with landholders and developers to enhance natural habitat on private land;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Work with land owners to naturalize yards adjacent to the GIN;
- Retain large lot sizes (in accordance with zoning) adjacent to Colebrook Park;
- Protect and enhance east – west forest corridor from Colebrook Park to Delta.

OPPORTUNITIES

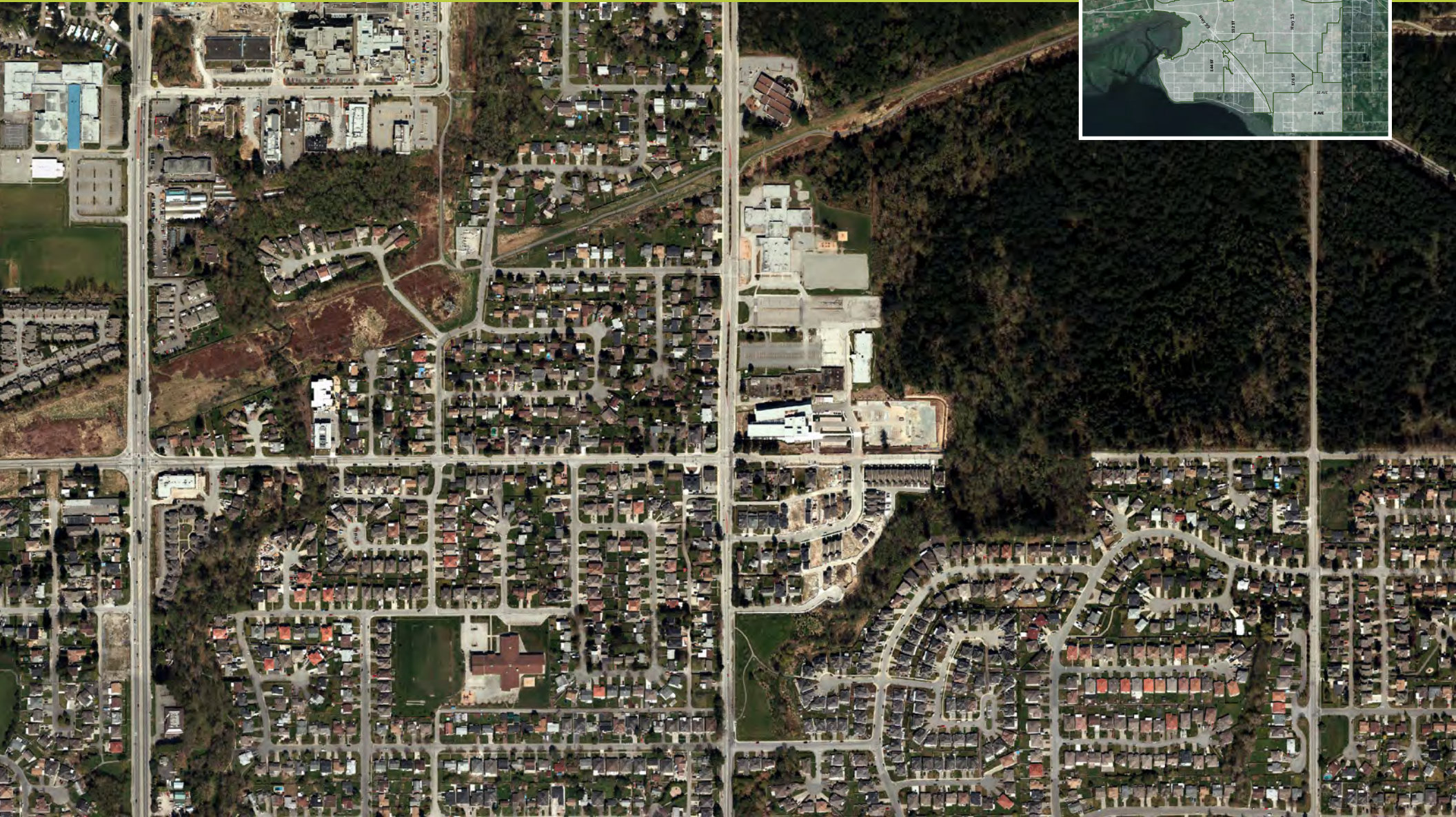
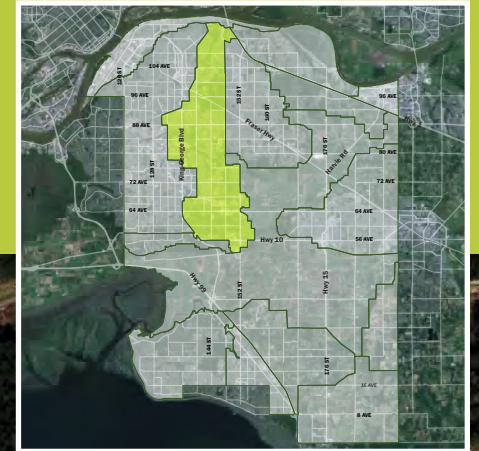
- Large residential lots with high forest cover bordering Colebrook Park;
- Significant tracts of remnant forest and natural area to the west in Delta.

CONSTRAINTS

- Low to medium density residential development with few remaining natural areas;
- Major transportation corridor (Highway 10, King George Blvd).

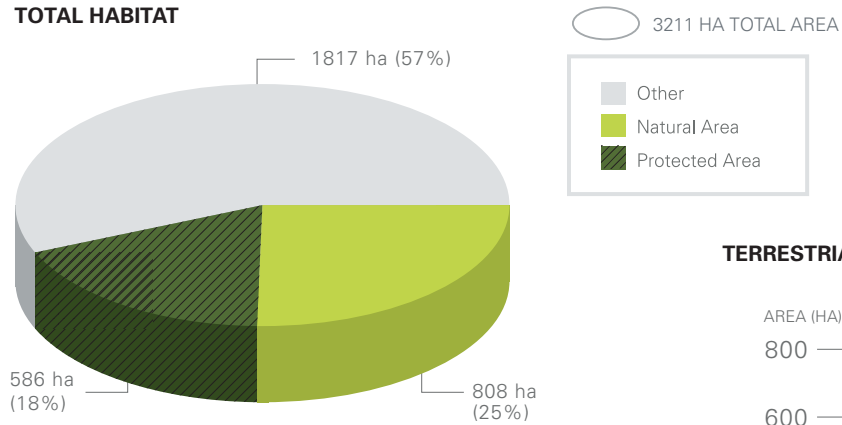
COLEBROOK					
Total Area		Natural Area		Protected Area	
457 ha		128 ha (28%)		43 ha (9%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
0 (0%)	0 (0%)	107 (23%)	29 (6%)	21 (5%)	5 (1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
2.2 km		1.2 km		0	7
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
29 ha	12 ha (41%)	3 ha (10%)	3 ha (11%)	11 ha (38%)	

Green Timbers Management Area

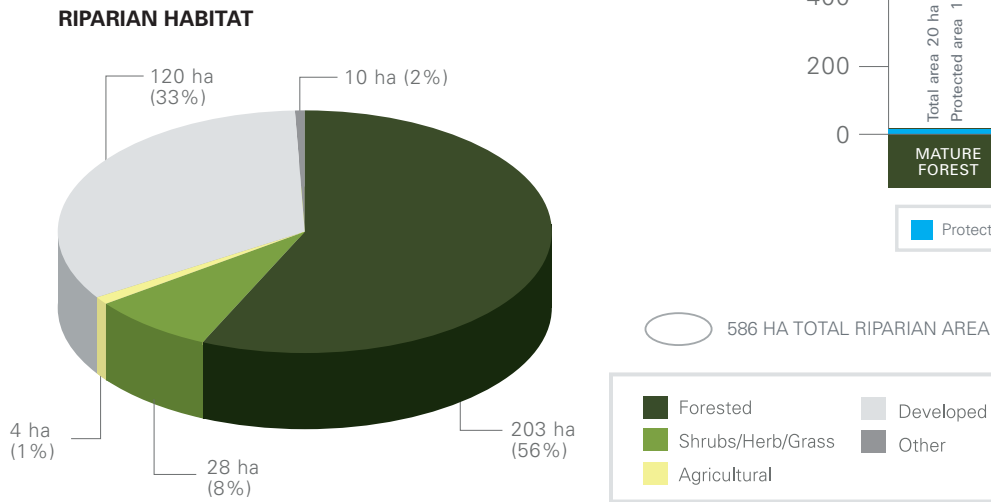


Upland area of North Surrey connecting the ALR to the Fraser River

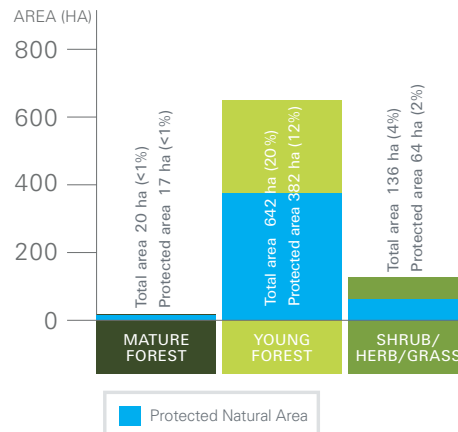
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Improve habitat connectivity between major hubs/natural areas;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Work with land owners to naturalize yards adjacent to the GIN;
- Enhance north south corridor between Fraser River and the ALR;
- Expand and enhance riparian habitat to support fish and wildlife, and protect water quality;
- Increase the number of wetlands;
- Remove barriers to movement along BC Hydro Right-of-Way.

OPPORTUNITIES

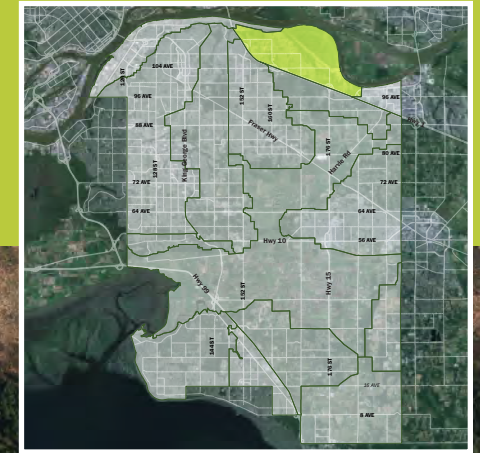
- Re-development of lower density neighbourhoods;
- Encroachment into riparian habitat can be restored;
- Naturalization of golf courses, cemeteries and BC Hydro Hydro Right-of-Way;
- BC Hydro and Gas Right-of-Way may be enhanced into higher functioning corridors.

CONSTRAINTS

- Most natural areas already protected;
- Established and built out residential neighborhoods;
- Major transportation corridors (Fraser Highway, King George Blvd, 152 Street, rail yard to north);
- Existing development within riparian setbacks.

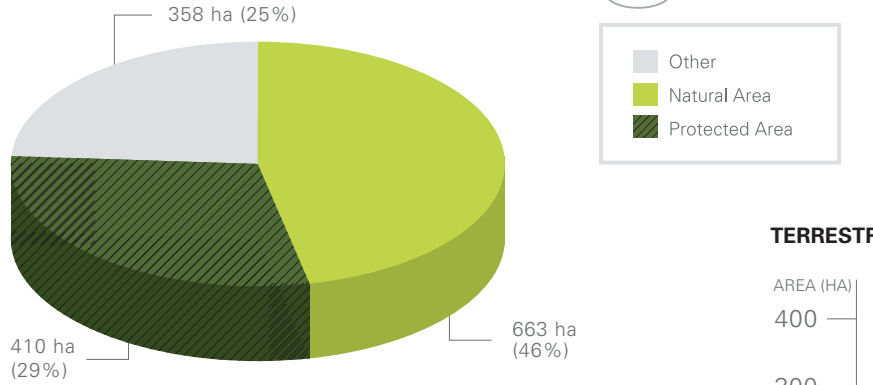
GREEN TIMBERS					
Total Area		Natural Area		Protected Area	
3211 ha		808 ha (25%)		586 ha (18%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
20 (<1%)	17 (<1%)	642 (20%)	382 (12%)	136 (4%)	64 (2%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
47.1 km		15.1 km		7	12
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
365 ha	203 ha (56%)	28 ha (8%)	4 ha (1%)	120 ha (33%)	

Surrey Bend Management Area

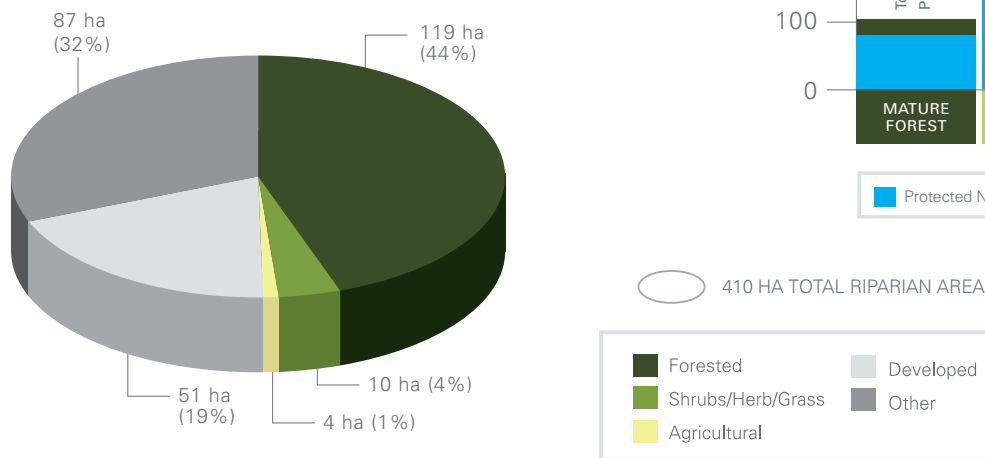


North east Surrey bordering Fraser River and bounded by Trans Canada Hwy

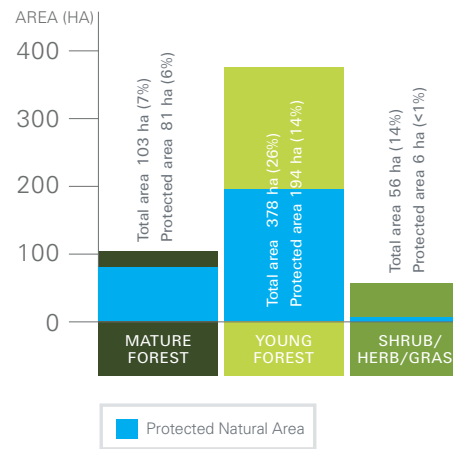
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Protect ecological integrity of Surrey Bend Regional Park;
- Work with land owners to naturalize yards adjacent to the GIN;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Maintain and enhance habitat connectivity on north escarpment;
- Restore any pollution or contamination associated with land fill;
- Retain a continuous forested buffer along the Fraser River;
- Enhance riparian areas to support fish and wildlife and protect water quality.

OPPORTUNITIES

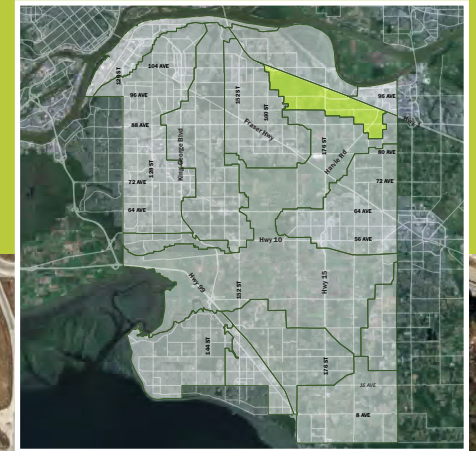
- Re-development of low to medium density residential neighbourhoods;
- Restoration of lowland watercourses and riparian areas;
- Steep forested slopes adjacent to South Fraser Perimeter Road;
- Restoration of the Port Mann land fill.

CONSTRAINTS

- Most available natural areas already protected;
- Mostly developed (low to medium density residential) south of escarpment;
- Major transportation corridors (Hwy 1 and South Fraser Perimeter Road, Railway).

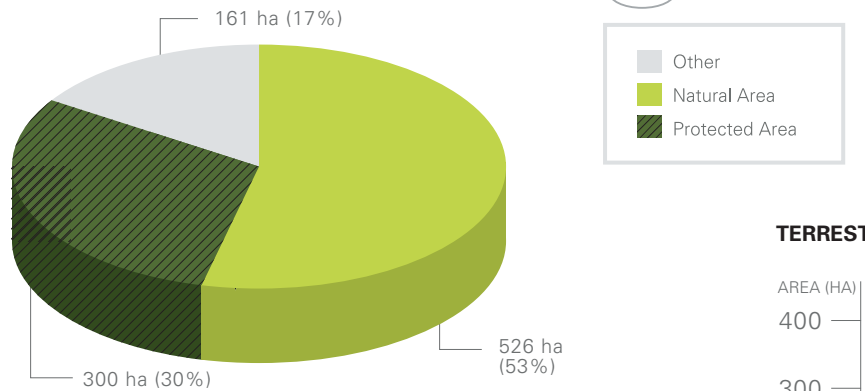
SURREY BEND					
Total Area		Natural Area		Protected Area	
1431 ha		663 ha (46%)		410 ha (29%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
103 (7%)	81 (6%)	378 (26%)	194 (14%)	56 (4%)	6 (<1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
32.2 km		14.2 km		16	4
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
271 ha	119 ha (44%)	10 ha (4%)	4 ha (1%)	51 ha (19%)	

Tynehead Management Area

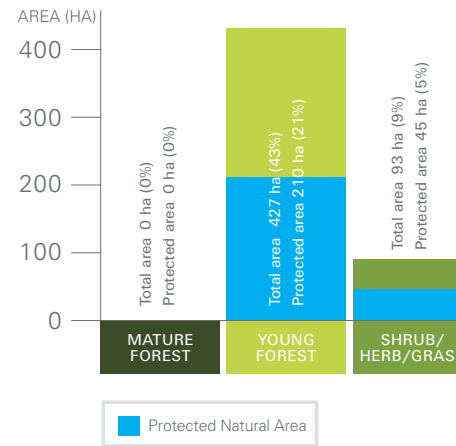


Northeast Surrey, South of Hwy 1 and north of ALR

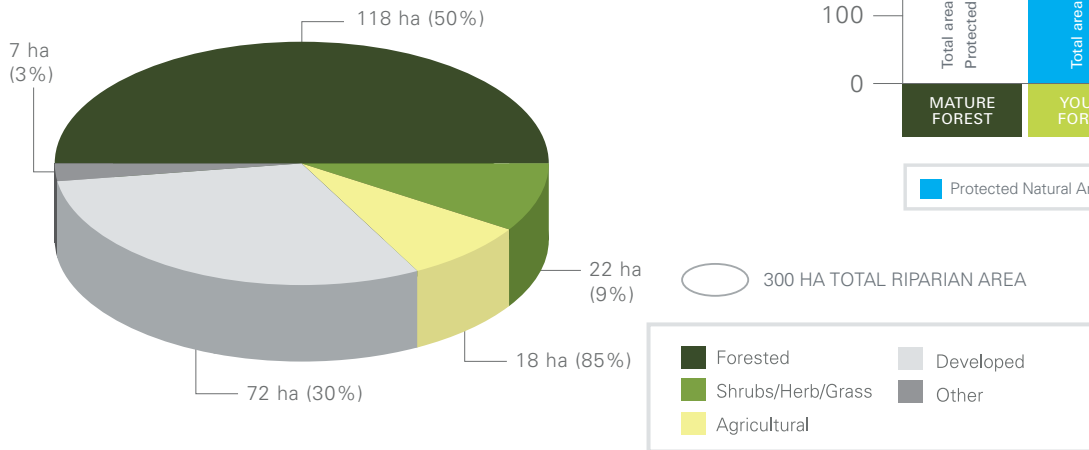
TOTAL HABITAT



TERRESTRIAL HABITAT



RIPARIAN HABITAT



MANAGEMENT OBJECTIVES

- Preserve natural and semi-natural habitat on private land during re-development;
- Establish movement corridors connecting Tynehead Park to the ALR;
- Work with landholders to maintain and enhance natural habitat on private land;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Work with land owners to naturalize yards adjacent to the GIN;
- Increase tree cover adjacent to the ALR;
- Increase the number of wetlands and ponds.

OPPORTUNITIES

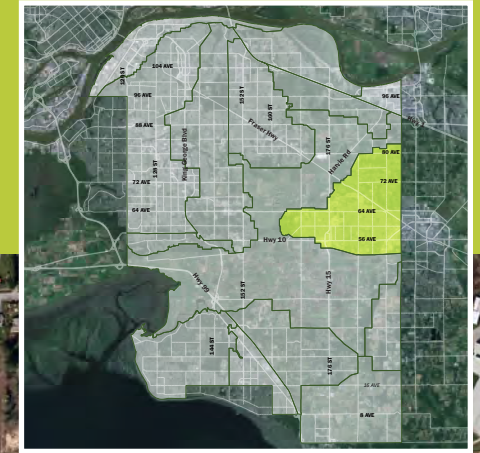
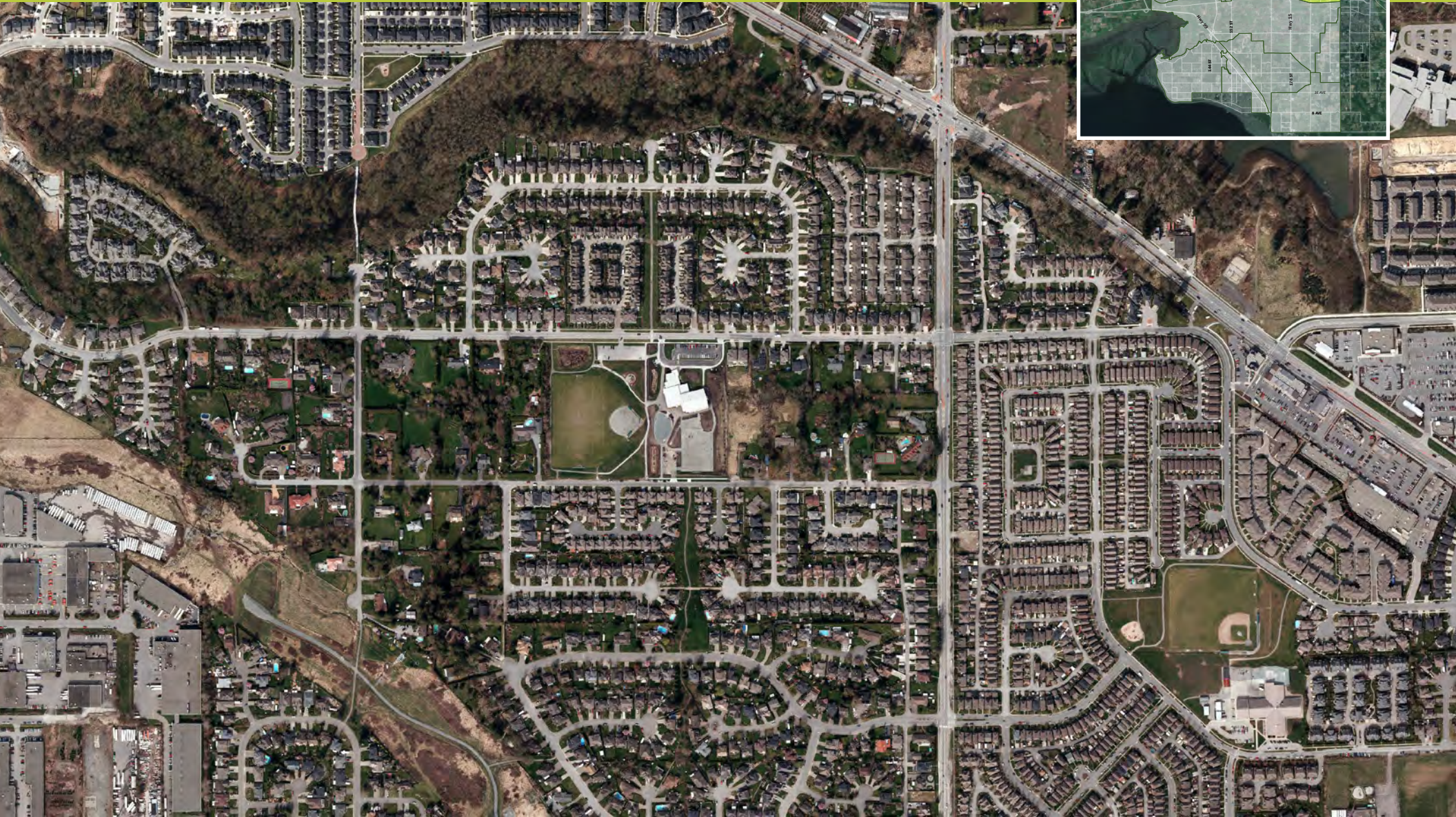
- Tynehead park is a significant natural area/hub;
- Retain and enhance corridors and core areas of hubs and sites when urban development occurs;
- High percentage forest cover and large remnant forest patches.

CONSTRAINTS

- Approved land use planning in place or in progress;
- Major transportation corridors (Hwy 1, Pacific Highway, Golden Ears Way, 96th Avenue).

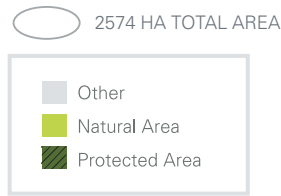
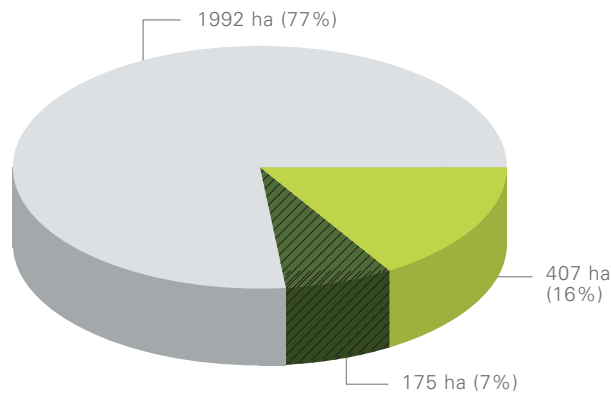
TYNEHEAD					
Total Area		Natural Area		Protected Area	
987 ha		526 ha (53%)		300 ha (30%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
0 (0%)	0 (0%)	427 (43%)	210 (21%)	93 (9%)	45 (5%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
23.9 km		20 km		7	3
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
237ha	118 ha (50%)	22 ha (9%)	18 ha (8%)	72 ha (30%)	

Cloverdale Management Area

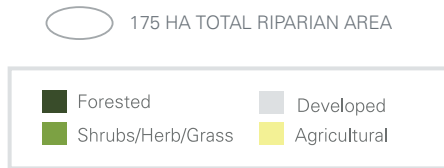
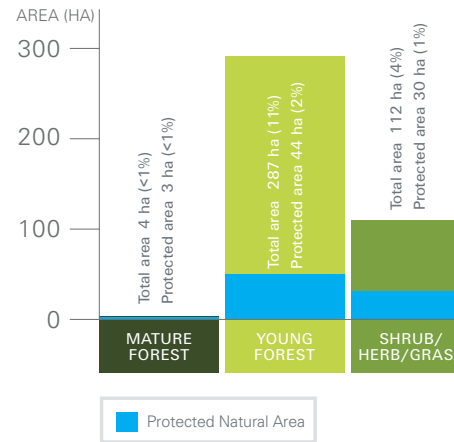


East Surrey between Langley and the ALR

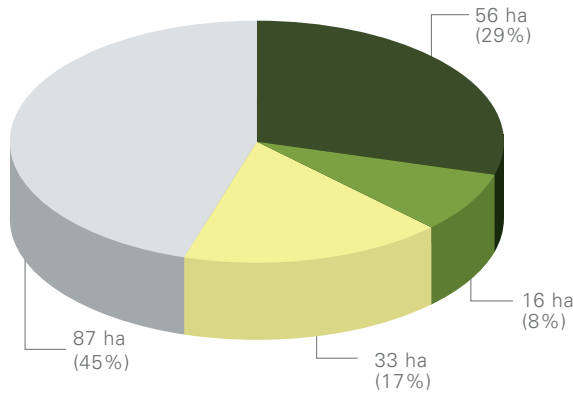
TOTAL HABITAT



TERRESTRIAL HABITAT



RIPARIAN HABITAT



MANAGEMENT OBJECTIVES

- Support initiatives to enhance local biodiversity in urban matrix;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Protect significant stands of remnant forest and riparian habitat;
- Increase landscape permeability (amount of natural and semi-natural habitat) on public and private land;
- Enhance connectivity to ALR land to north;
- Increase tree canopy cover;
- Increase tree cover adjacent to the ALR;
- Increase the number of wetlands and ponds.

OPPORTUNITIES

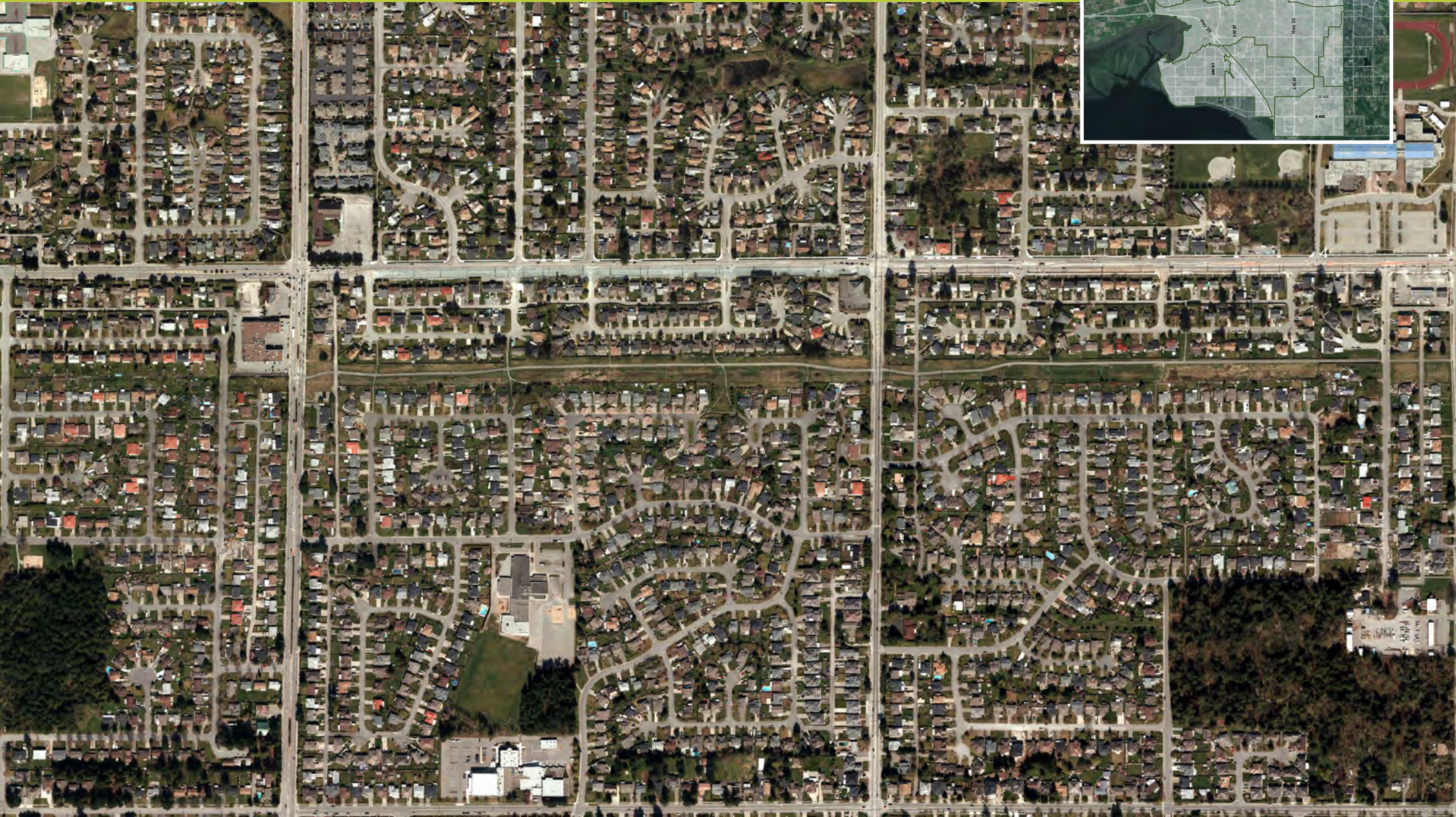
- Large remaining forested patches in north part of Clayton Heights;
- Redevelopment of lower density residential neighbourhoods;
- Intact riparian corridors in the north;
- Upper headwaters of Serpentine River extend into Langley;
- Linear Hydro Right-of-Way through south section provides opportunity for functional connectivity.

CONSTRAINTS

- South portion densely developed;
- Approved land use planning in place or in progress for north portion;
- Major transportation corridors (Fraser Highway, Pacific Highway);
- Few remaining natural areas south of Fraser Highway.

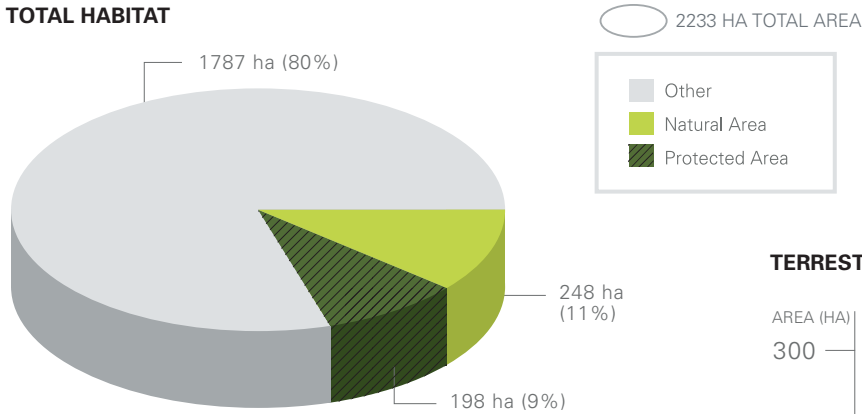
CLOVERDALE					
Total Area		Natural Area		Protected Area	
2574 ha		407 ha (16%)		175 ha (7%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
4 (<1%)	3 (<1%)	287 (11%)	44 (2%)	112 (4%)	30 (1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
16.4 km		19.1 km		2	12
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
196 ha	56 ha (29%)	16 ha (8%)	33 ha (17%)	87 ha (45%)	

Fleetwood Management Area

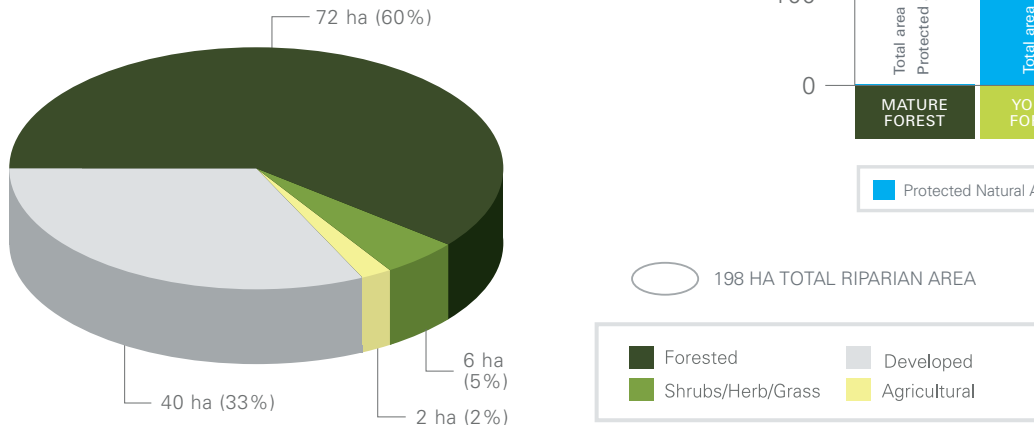


North Surrey bounded by ALR to south and east, and Green Timbers to northwest.

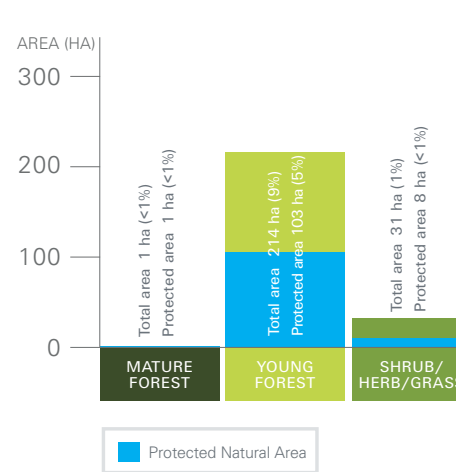
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Support initiatives to enhance local biodiversity in urban matrix;
- Increase landscape permeability (amount of natural and semi-natural habitat) on public and private land;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Provide functional corridor along the southern ALR border;
- Work with landowners to naturalize yards adjacent to riparian areas;
- Increase tree canopy cover;
- Increase the number of wetlands and ponds.

OPPORTUNITIES

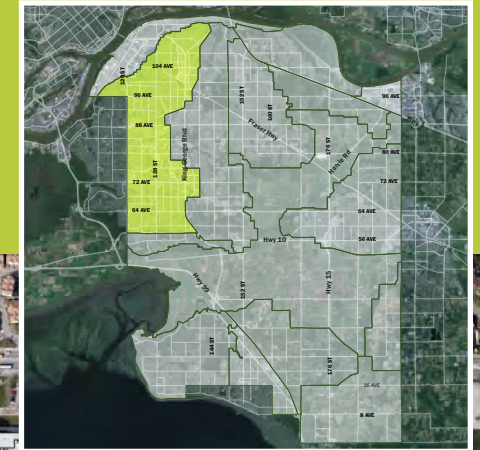
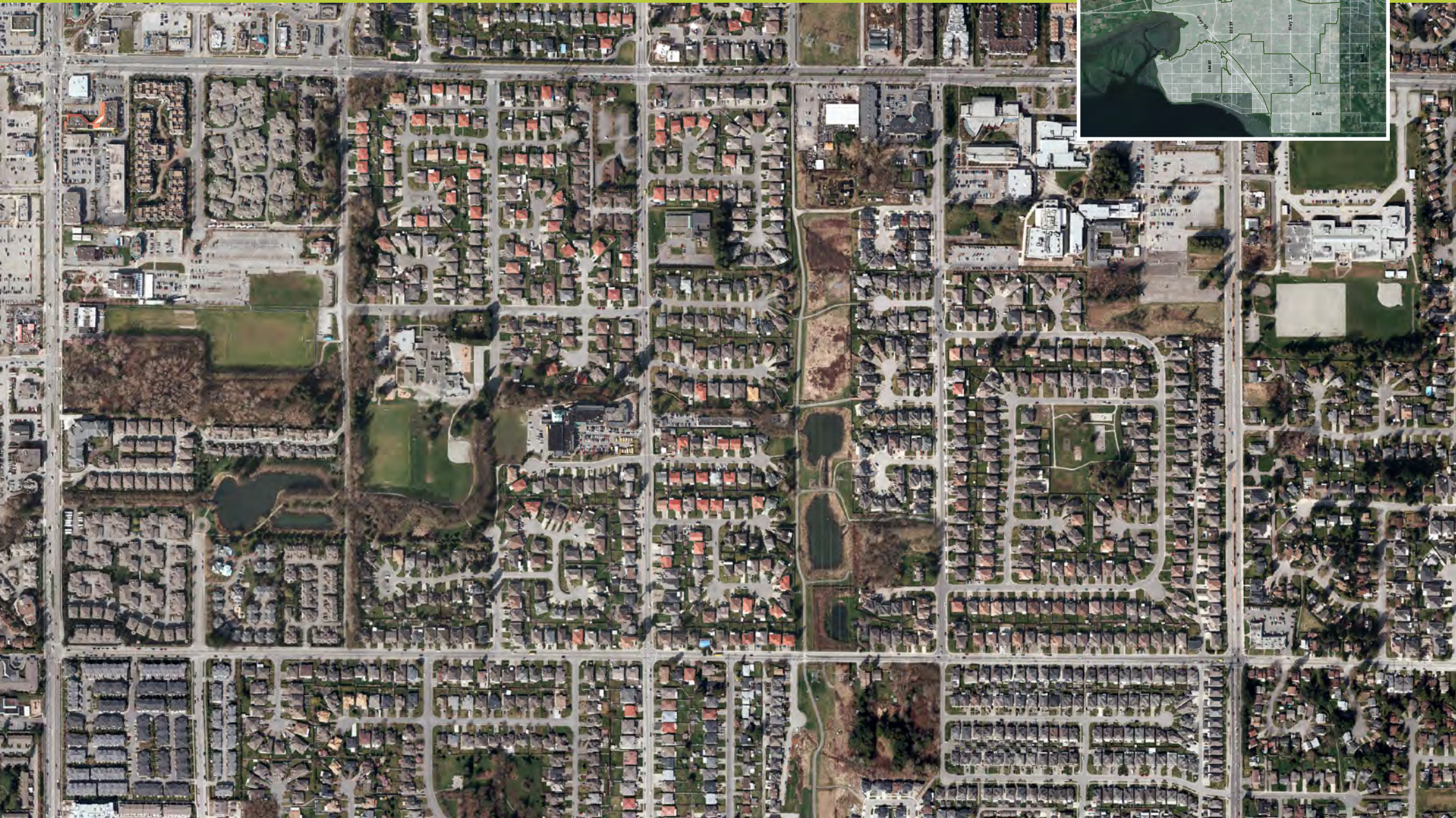
- Forested communities along the border with the ALR;
- East west greenway between Green Timbers and Tynehead;
- Headwaters of tributaries of Serpentine River;
- Rights-of-Way Hydro and Gas may provide corridors.

CONSTRAINTS

- Most natural areas already protected;
- Established and built out residential and commercial neighborhoods;
- Few intact natural areas remain;
- Major transportation corridors (Fraser Highway).

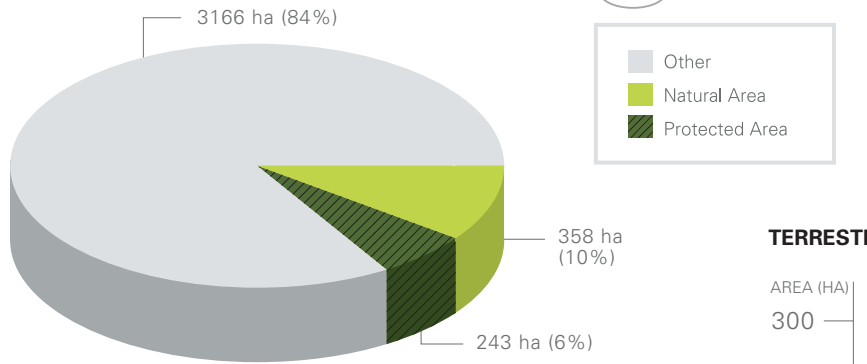
FLEETWOOD					
Total Area		Natural Area		Protected Area	
2233 ha		248 (11%)		198 (9%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
1 (<1%)	1 (<1%)	214 (9%)	103 (5%)	31 (1%)	8 (<1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
13.3 km		7.7 km		4	2
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
121 ha	72 ha (60%)	6 ha (5%)	2 ha (2%)	40 ha (33%)	

Newton Management Area

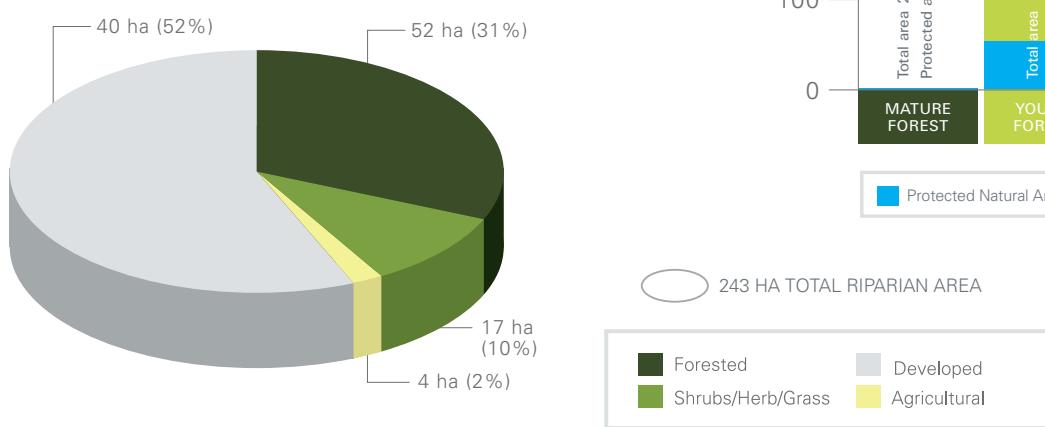


West Surrey, north of Highway 10

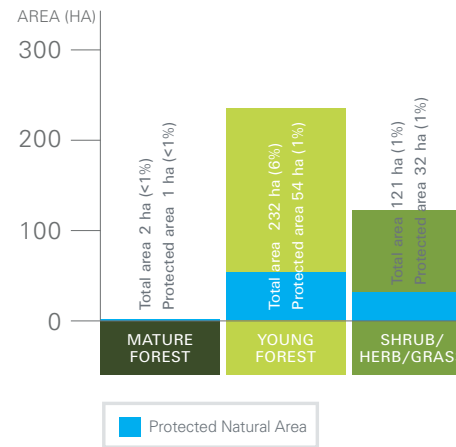
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Support initiatives to enhance local biodiversity in urban matrix;
- Protect remaining forested habitat on north periphery adjacent to industrial land;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Establish functional east west corridor along north boundary;
- Increase landscape permeability (amount of natural and semi-natural habitat) on public and private land;
- Increase tree canopy cover;
- Increase the number of wetlands and ponds.

OPPORTUNITIES

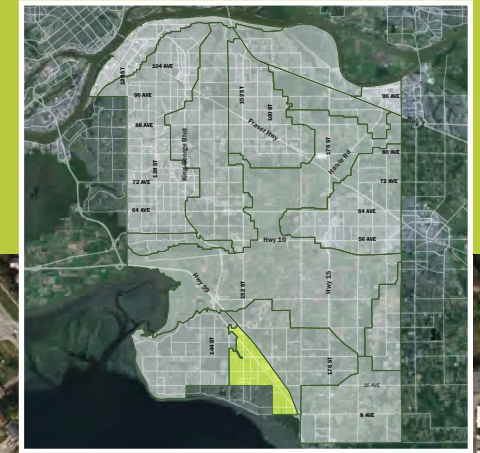
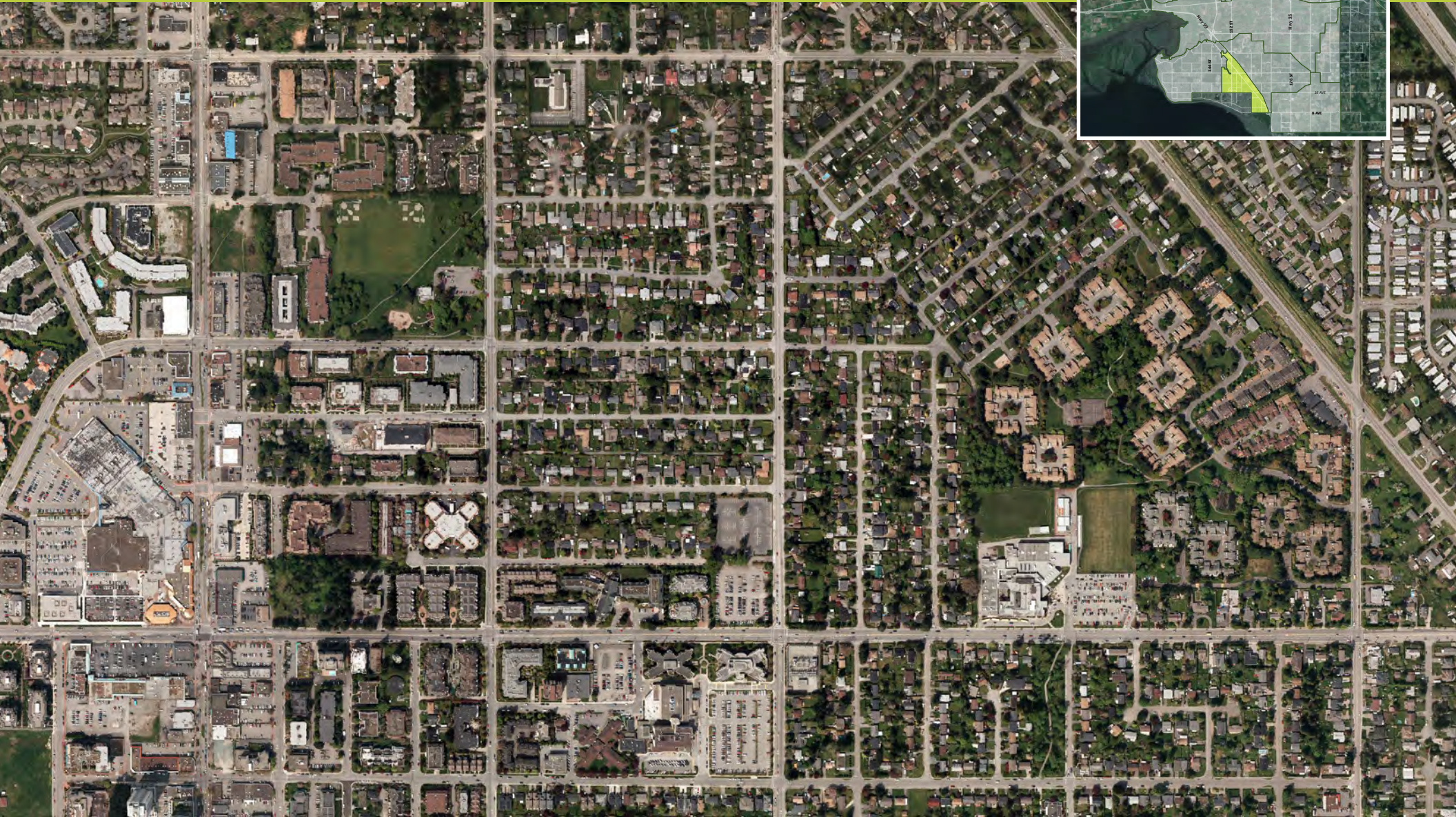
- Intact riparian corridor along Cougar Creek;
- Linear Hydro Right-of-Way provides opportunity for functional connectivity.

CONSTRAINTS

- Most natural areas already protected;
- Established and built out residential and commercial neighbourhoods;
- Few intact natural areas remain;
- Major transportation corridors (Highway 10, King George Blvd)

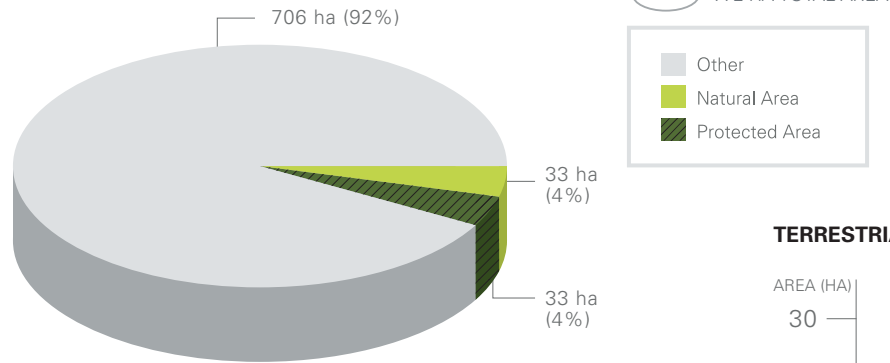
NEWTON					
Total Area		Natural Area		Protected Area	
3767 ha		358 ha (10%)		243 ha (6%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
2 (<1%)	1 (<1%)	232 (6%)	54 (1%)	121 (3%)	32 (1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
10.3 km		9.9 km		3	10
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
169 ha	52 ha (31%)	17 ha (10%)	2 ha (2%)	96 ha (57%)	

South Surrey Management Area

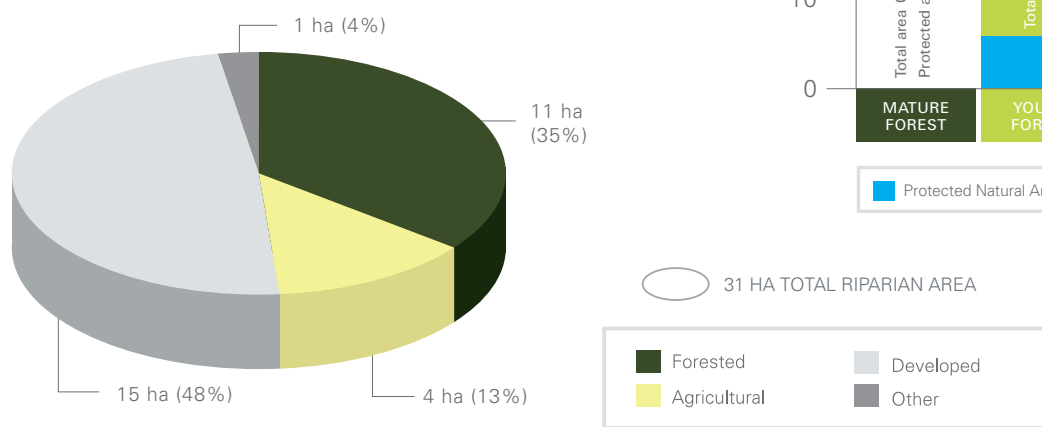


South Surrey west of Highway 99

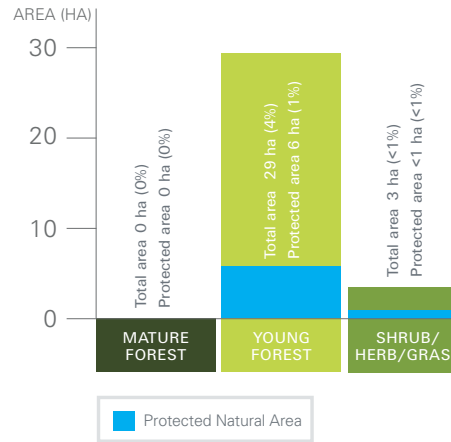
TOTAL HABITAT



RIPARIAN HABITAT



TERRESTRIAL HABITAT



MANAGEMENT OBJECTIVES

- Support initiatives to enhance local biodiversity in urban matrix;
- Increase landscape permeability (amount of natural and semi-natural habitat) on public and private land;
- When development is proposed adjacent to natural areas, encourage alternative development concepts that allow for greater protection of these natural areas;
- Increase tree canopy cover;
- Increase the number of wetlands and ponds.

OPPORTUNITIES

- Adjacent large natural area on the Semiahmoo Indian Reserve;
- Naturalization of Semiahmoo greenway;
- Naturalization of streams and riparian areas.

CONSTRAINTS

- Established and built out residential and commercial neighborhoods;
- Few intact natural areas remain;
- Major transportation corridors (Hwy 99, King George Blvd).

SOUTH SURREY					
Total Area		Natural Area		Protected Area	
772 ha		33 ha (4%)		31 ha (4%)	
Terrestrial Habitat					
Mature Forest		Young Forest		Shrub/Herb/Grass	
Total Area	Protected Area	Total Area	Protected Area	Total Area	Protected Area
0 (0%)	0 (0%)	29 (4%)	6 (1%)	3 (<1%)	<1 (<1%)
Aquatic Habitat					
Length of Class A Creeks		Length of Class B Creeks		# Wetlands	# Ponds
2.4 km		1.6 km		0	4
Riparian Habitat					
Riparian Area	Forested	Shrub/Herb/Grass	Agricultural	Developed	
31 ha	11 ha (35%)	0 ha (0%)	4 ha (13%)	15 ha (48%)	

Representative Species

It is important to recognize the significant land use changes that have occurred in the region, either through natural disturbance (e.g. fire, wind, flooding, insect pests and forest disease) or human caused (e.g. logging, agriculture, development). These events play a significant role in shaping and modifying ecosystems, and have significant impacts on biodiversity. As a result, some species have been extirpated over time. Today, many of the species present are either somewhat tolerant or have learned to adapt to urban landscapes. This BCS focuses on management of native species that are present today, to help ensure their continued population health and persistence over time.

Wildlife species considered best representative of each Management Class were identified. Objectives, recommendations and priority actions for each Management Class and Unit are based on the management requirements of these species. Indicator species were identified as part of a long term biodiversity monitoring strategy to help assess development impacts and evaluate management actions.

Mammals

	AGRICULTURAL	INDUSTRIAL	SUBURBAN SOUTH	SUBURBAN NORTH	URBAN
Black-tailed Deer	•		•	•	
Bat species	•		•	•	
Common Shrew					•
Coyote	•		•	•	
Creeping Vole	•		•	•	•
Douglas Squirrel	•		•	•	
Ermine			•	•	
Mink	•		•	•	
Mouse/ Shrew/Vole sp.	•	•	•	•	•
Muskrat	•		•	•	
Northern Flying Squirrel			•		
Pacific Water Shrew	•		•	•	
Raccoon		•			•
River Otter	•		•	•	
Shrew Mole	•				•
Striped Skunk	•		•		
Townsend's Vole	•		•	•	
Trowbridge's Shrew	•			•	
Vagrant Shrew					•
Virginia Opossum		•			•

Amphibians/Reptiles

	AGRICULTURAL	INDUSTRIAL	SUBURBAN SOUTH	SUBURBAN NORTH	URBAN
Northern Red-legged Frog	•		•	•	
Common Garter Snake	•		•	•	•
Long-toed Salamander	•	•	•	•	•
Northwestern Garter Snake			•		
Northwestern Salamander	•	•	•		
Pacific Treefrog	•	•	•	•	•
Western Toad	•				

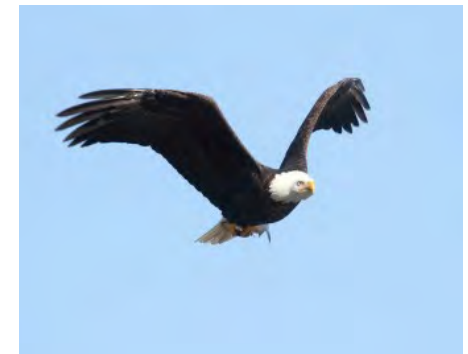
Fish

	AGRICULTURAL	INDUSTRIAL	SUBURBAN SOUTH	SUBURBAN NORTH	URBAN
Coastal Cutthroat Trout	•			•	
Coho Salmon	•	•	•	•	•

Table 9: Indicator species for these guilds are shown in black text.

 Birds

	AGRICULTURAL	INDUSTRIAL	SUBURBAN SOUTH	SUBURBAN NORTH	URBAN
American Robin		•			•
Bald Eagle	•		•	•	
Band-tailed Pigeon	•		•		
Barn Owl	•		•		
Barn Swallow	•		•	•	
Belted Kingfisher	•		•	•	
Black-capped Chickadee		•			•
Brown Creeper			•	•	
Bushtit		•			•
California Gull					
Canada Goose		•			•
Common Goldeneye	•		•	•	
Common Yellowthroat	•				
Cooper's Hawk				•	
Dark-eyed Junco		•			•
Downy Woodpecker	•	•	•	•	•
Great Blue Heron	•		•	•	
Great Horned Owl			•	•	
Green Heron	•		•		
Gyr Falcon					
Hooded Merganser	•		•	•	
House Finch		•	•	•	•
Lincoln's Sparrow	•		•		
Mallard		•			•
Northern Flicker			•	•	
Northern Harrier	•				
Northwestern Crow		•			•
Pacific Wren				•	
Pacific-slope Flycatcher	•		•	•	
Peregrine Falcon	•		•		
Pileated Woodpecker	•		•		
Red-breasted Sapsucker				•	
Red-eyed Vireo			•	•	
Red-tailed Hawk	•		•	•	
Savannah Sparrow	•				
Shorebirds	•		•	•	
Short-eared Owl	•		•		
Song Sparrow	•	•	•	•	•
Spotted Towhee	•	•	•	•	•
Swainson's Thrush	•			•	
Trumpeter Swan	•		•		
Vaux's Swift			•	•	
Warbling Vireo	•		•	•	
Western Meadowlark	•				
Willow Flycatcher	•			•	
Yellow Warbler	•		•	•	





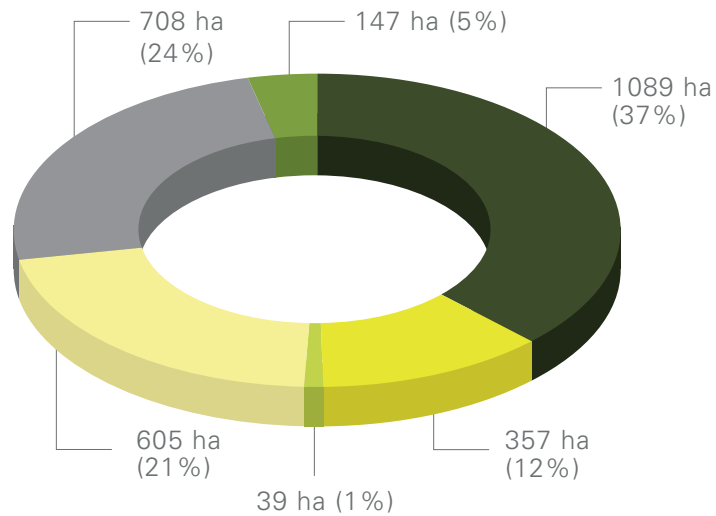
Biodiversity Strategy GREEN INFRASTRUCTURE NETWORK

- GREEN INFRASTRUCTURE NETWORK 
- PROTECTED HUBS AND SITES 
- UNPROTECTED HUBS AND SITES 
- REGIONAL CORRIDORS 
- LOCAL CORRIDORS 
- SUPPORTING PARK SITES 
- AGRICULTURAL LAND RESERVE 

JUNE 2014

Data Sources: City of Surrey
Data Developed By: Diamond Head Consulting Ltd.
Map Design: Ecoplan International

Green Infrastructure Network



COVER CLASSES

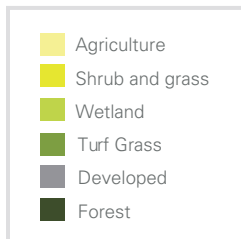


Figure 6: State of natural habitat within proposed GIN including corridors, sites and hubs (2011).

Habitat loss has been identified as the number one threat to biodiversity (IUCN, 2012). The creation of isolated habitat patches hinders the ability of certain species to move across the landscape. Ensuring connectivity between large habitat areas is a key component of this strategy. A *Green Infrastructure Network* (GIN) is a conservation strategy that addresses the unique challenges of achieving habitat connectivity in the urban environment.

Habitat hubs, sites and corridors provide the framework for the GIN. These were initially identified in the EMS (2011). These components were further assessed and prioritized in this Strategy. Considerations when identifying the GIN included

wildlife behavior, planned development, greenways, protected areas and cost benefit.

Land use and development (roads, buildings, infrastructure, industry, agriculture, etc) over time has reduced natural connectivity in the City. Much of the proposed GIN includes remaining protected areas and riparian corridors (which have required set-back widths). Natural features on private land and the ALR are also essential to preserving biodiversity; however, the City has limited land use planning authority in these areas. Due to the degree of habitat fragmentation at present, a long-term process, involving systematic protection, enhancement, restoration and re-development, will be required to achieve the proposed GIN.

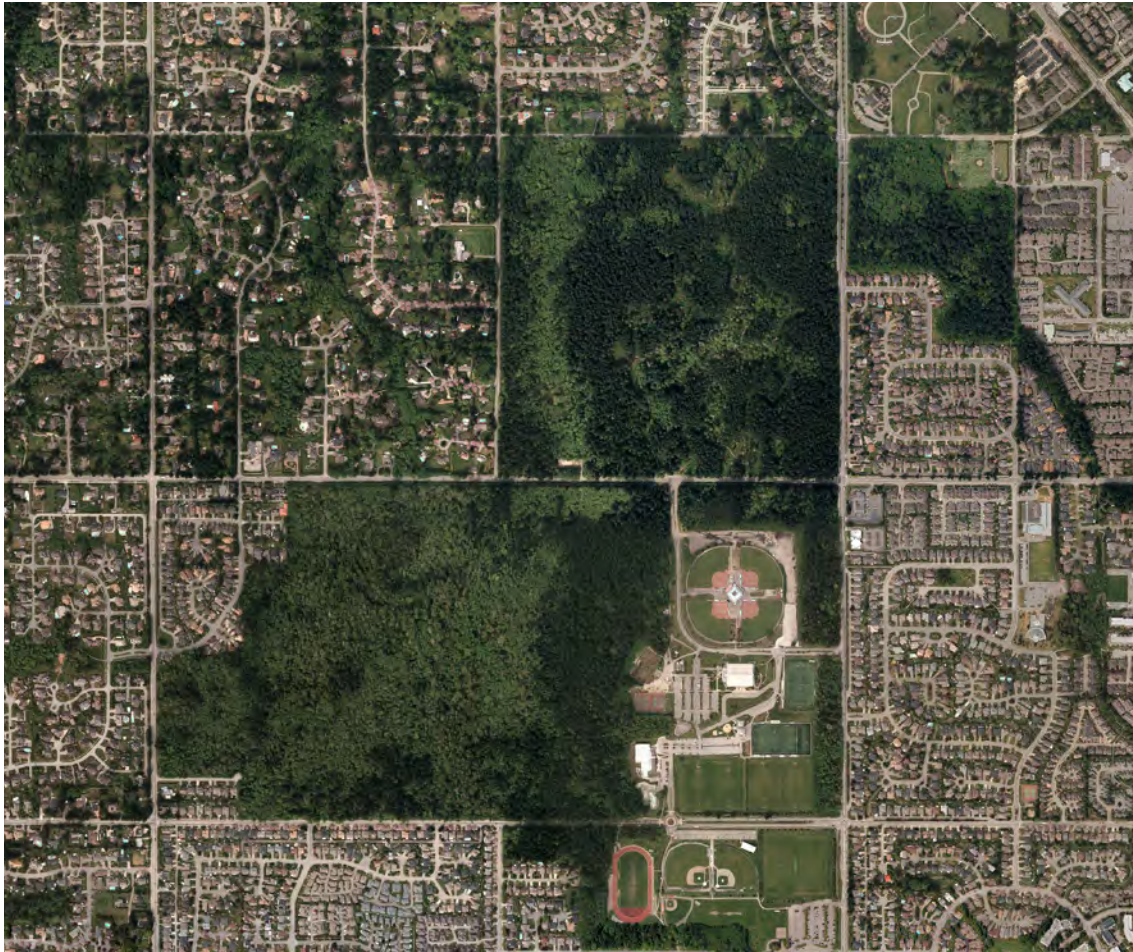
Recommended corridors are labeled as numbers. Priority unprotected hubs and sites are labeled as letters. General characteristics and recommendations are provided for each corridor and proposed hub identified in the GIN (Appendix J).

The habitat that currently exists within the target corridor widths is summarized. About one half of the corridors are in a natural state. The other half is disturbed from development or being used for agriculture. This analysis should be undertaken every five years to evaluate the progress in achieving GIN objectives.

A GIN is an interconnected system of natural areas and open space that conserves ecosystems and functions, while providing benefits to both wildlife and people (Benedict and McMahon, 2006).

The GIN has been developed following three core principles of biodiversity conservation:

1. **Preserving large core habitat areas.** Large patches of natural habitat provide refuge areas for species that are less tolerant of human activity.
2. **Ensuring connectivity between habitat areas.** Healthy populations of species require that there is genetic diversification. To achieve this, populations must be connected so they can intermix.
3. **Providing a diversity of habitat features.** Species may use a variety of habitats and features at different times in their life cycles. These habitats and features must be preserved to maintain species over the long term.



Sunnyside Acres Urban Forest - a significant hub in the City.

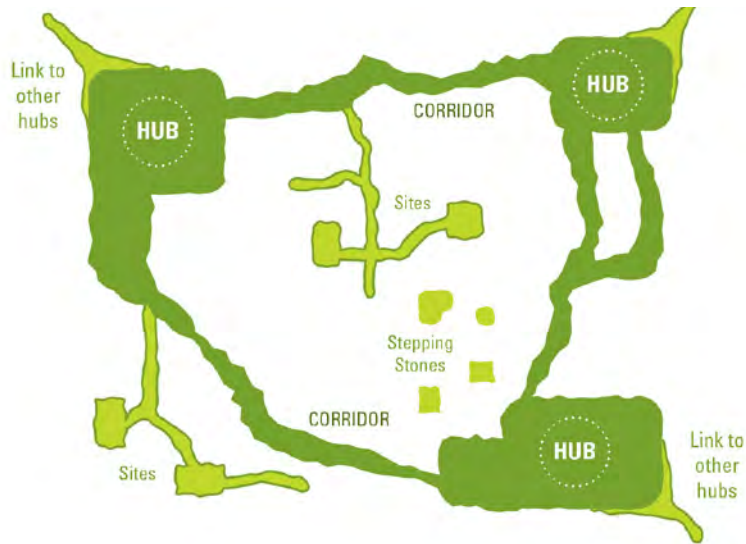
Hubs and Sites

Key habitat areas were identified across the City. These vary by type, size, and condition; however, all are necessary to support biodiversity. Large intact core habitat areas (hubs) are fundamental to the success of the GIN. Many of these are already protected such as Green Timbers and Sunnyside Urban Forests, Surrey Bend and Tynehead Regional Parks. High value non-protected hubs and sites have been identified based on proximity to the GIN, ownership, quality of habitat and occurrence of rare or sensitive habitat. These areas include some of the last large unprotected continuous natural areas within the City. Some of the smaller areas that have been identified support a number of high value habitat features. Protection and enhancement of these identified hubs and sites should be the priority when allocating resources.

HUBS CHARACTERISTICS	SITES CHARACTERISTICS	RECOMMENDATIONS FOR THE MANAGEMENT OF HUBS AND SITES
<ul style="list-style-type: none"> ▪ Large intact habitat areas >10ha ▪ Provides habitat for a diversity of species ▪ Source areas for wildlife dispersal ▪ Provides interior (core) habitat and refuge areas ▪ Supports species with larger home ranges ▪ Refuges for species less tolerant of human disturbance ▪ May contain regionally important habitat 	<ul style="list-style-type: none"> ▪ Small habitat patches <10ha ▪ Provides habitat for fewer species ▪ Supports species with smaller home ranges ▪ Species more tolerant to human disturbance ▪ May contain locally rare or sensitive habitat ▪ May not be connected to GIN 	<ul style="list-style-type: none"> ▪ Acquire, restore and enhance prioritized core areas of unprotected hubs and sites; ▪ A natural areas management plan should be developed for each hub to limit disturbance from people and pets. This should include an analysis of habitat features and designation of wildlife refuge areas within hubs. Plan should include limitations on access and recreation based on habitat sensitivity. ▪ In each hub and site, manage for a diversity of habitat types and features. Create or enhance aquatic features (creeks, lakes, wetlands) where feasible.

Table 10 Characteristics of Hubs and Sites

Corridors



Corridors are linear habitat areas that encourage the movement of species between fragmented hubs and sites. This allows species to access new habitat features required to meet their life needs. It also allows for dispersal from source patches (areas with local population surplus). The ability for re-colonization is important to maintain genetic diversity among species populations. Corridors are also used to meet other objectives for example, recreational greenways are often planned in conjunction with wildlife corridors; however, this requires the consideration of ecological sensitivity and potential impacts of human disturbance.

Corridor width and habitat requirements vary depending on the species they are intended to support and where they are located within the City. Corridors identified in the GIN have been broadly categorized as Regional and Local. The classification of corridors does not reflect their importance. Rather it reflects the types of species that they are expected

to support. All of the recommended corridors should be considered a priority to establish.

The identification of corridors in the GIN does not exclude the importance of other corridors that exist. These corridors form the foundation of the movement network throughout the City. There are numerous other movement corridors including riparian setbacks, hydro and utility Right of Way, greenways and agricultural fields.

The concept of the GIN can be related to urban transportation plans. Highways and arterial roads are designated for the primary movement of people through urban areas. In addition to these main roadways, there are also a network of smaller roads, bike lanes and sidewalks. The regional and local corridors identified in the GIN can be thought of as arterial roadways. They are the designated primary corridors for species movement. However they do not exclude the importance of the smaller network of greenspace found throughout the urban matrix.

REGIONAL CORRIDORS CHARACTERISTICS	LOCAL CORRIDORS CHARACTERISTICS	RECOMMENDATIONS FOR THE MANAGEMENT OF CORRIDORS
<ul style="list-style-type: none"> ▪ Wider corridors (target 50-100 metres) ▪ Designed to provide movement for a wide range of species including that are less tolerant of human disturbance ▪ Limited recreation ▪ Regional connectivity ▪ Connect large habitat areas ▪ Riparian corridors of larger watercourses 	<ul style="list-style-type: none"> ▪ Narrower corridors (target 10-50 metres) ▪ Designed to provides movement of species that more tolerant of human disturbance ▪ Greenways through developed areas ▪ Hydro right of ways ▪ Connect smaller sites, fragmented habitat areas ▪ Riparian corridors of smaller watercourses 	<ul style="list-style-type: none"> ▪ Acquire, restore and enhance prioritized habitat areas along corridors ▪ Enforce target corridor widths for regional and local corridors ▪ Recreation trails and facilities should be located along one edge of any corridor. Trails should be outside the riparian setback areas and a minimum distance of 10m above the top of bank for ravines. Direct crossing of corridors should be avoided ▪ Identify private land owners encroaching into protected corridors

Table 11 Characteristics of Corridors

Road Crossings

Roads are a major constraint to establishing habitat connectivity. Major highways, in particular, can be a significant barrier to movement. Vehicle-wildlife collisions are a significant cause of wildlife mortality. Strategies to reduce human-wildlife conflicts and provide safe wildlife passage across major roads should be implemented. Options for road crossings must be considered in context of the species that they are targeting and their cost. Overpass structures are very expensive to build and are not necessarily more effective at facilitating crossing for the species found in urban environments. Underpasses are more cost effective and can be designed and constructed along road, culvert and bridge upgrades or maintenance.

The risk to wildlife increases with the level of traffic along a roadway. Priority for implementing underpasses should

focus on arterial and collector roads where they intersect GIN corridors. A monitoring program should be established to track the mortality of animals along roads in Surrey. Monitoring will help to prioritize areas for upgrading. Generally the wider the underpass is designed, the more effective it will be at facilitating wildlife passage. Clear-span bridges are recommended over arched or box culverts whenever feasible. All underpasses should be wide enough to provide terrestrial benches located above the high water mark. Entrance and exists should be naturalized with ground cover and cover features such as boulders and logs.

In areas where wildlife-vehicle collisions are common, fencing can be used to direct wildlife into the underpasses. Fencing should be designed to restrict the passage of

medium and large mammals. One way gates should be installed to prevent wildlife from being trapped in the road right of way.

Where the GIN corridors intersect local roads, traffic calming strategies should be implemented. Signage should be installed to inform the public of the wildlife crossings.

Speed limits should be reduced in areas that are a high concern. Lighting should be minimized and streets narrowed with strategic cover of vegetation and objects on either side.

Strategies for road crossings should be developed in a City wildlife signage plan. Wildlife road crossings should be identified, assessed and prioritized, and include site specific recommendations for their management.



RECOMMENDATIONS AND CONSIDERATIONS FOR ROAD CROSSINGS		
LOCAL ROADS	FENCING	ROAD UNDERPASSES
Install wildlife crossing signs Reduce speed limits Narrow roadways Provide cover objects and/or vegetation on road edges Reduce lighting at crossing	Fencing should be considered along roadways with high incidence of wildlife mortality resulting from collisions Fencing should be designed to restrict the movement of medium and large mammals One way gates should be installed in fencing to prevent wildlife from being trapped in the road right of way Wildlife should be discouraged from crossing busy highways and roads. A combination of fencing and habitat augmentation can be used to help control and direct movement along busy transportation corridors Fencing should be considered along the GIN and in combination with strategic gaps, underpasses or overpasses.	Bridge and culvert replacement projects provide an opportunity to widen and naturalize underpasses Structures to consider include arched or box culverts and clear-span bridges The larger the underpass area the more effective it is for wildlife movement Size and openness of structures matter: Large species (e.g. deer) – min. 7 m width, 4 m height Medium species (e.g. weasel) - min. 2 m width Small species (e.g. amphibians) – min. 0.5 m width Sightlines, natural substrate and vegetation encourage movement Entrance and exists should be naturalized with ground cover and cover features

Table 12 Recommendations and considerations for road crossings



Highway 1

Biodiversity in the Urban Matrix

The GIN forms the backbone of this *Biodiversity Conservation Strategy*. It protects a network of natural areas across the City, ensuring most species of wildlife have a minimum amount of habitat. However, this GIN will only cover a fraction of the City when fully implemented. The remaining landbase consists of agricultural land and developed areas (the urban matrix). There is a multitude of smaller natural and constructed features in the urban matrix that accumulatively to support biodiversity in Surrey. Citizens and the City can play an important role to preserve, enhance and create these features.

Building public awareness and promoting stewardship of habitat in the City is a key component of this strategy. Naturalizing the urban matrix contributes to biodiversity by increasing the area of contiguous habitat and providing areas of refuge.

Naturescaping is a landscaping strategy that focuses on native vegetation and the creation of habitat. In addition to supporting wildlife, naturescaping also provides a number of indirect benefits:

- Reduced use of pesticide and fertilizers;
- Higher amount of rainwater interception and infiltration into ground (i.e. decreasing requirements for stormwater infrastructure);
- Lower greenhouse gas emissions (e.g. less lawn to mow);
- More local food production by encouraging backyard and community gardens and planting of fruit trees.
- Fewer hard surfaces, which can help lower temperatures and reduce the urban heat island effect;

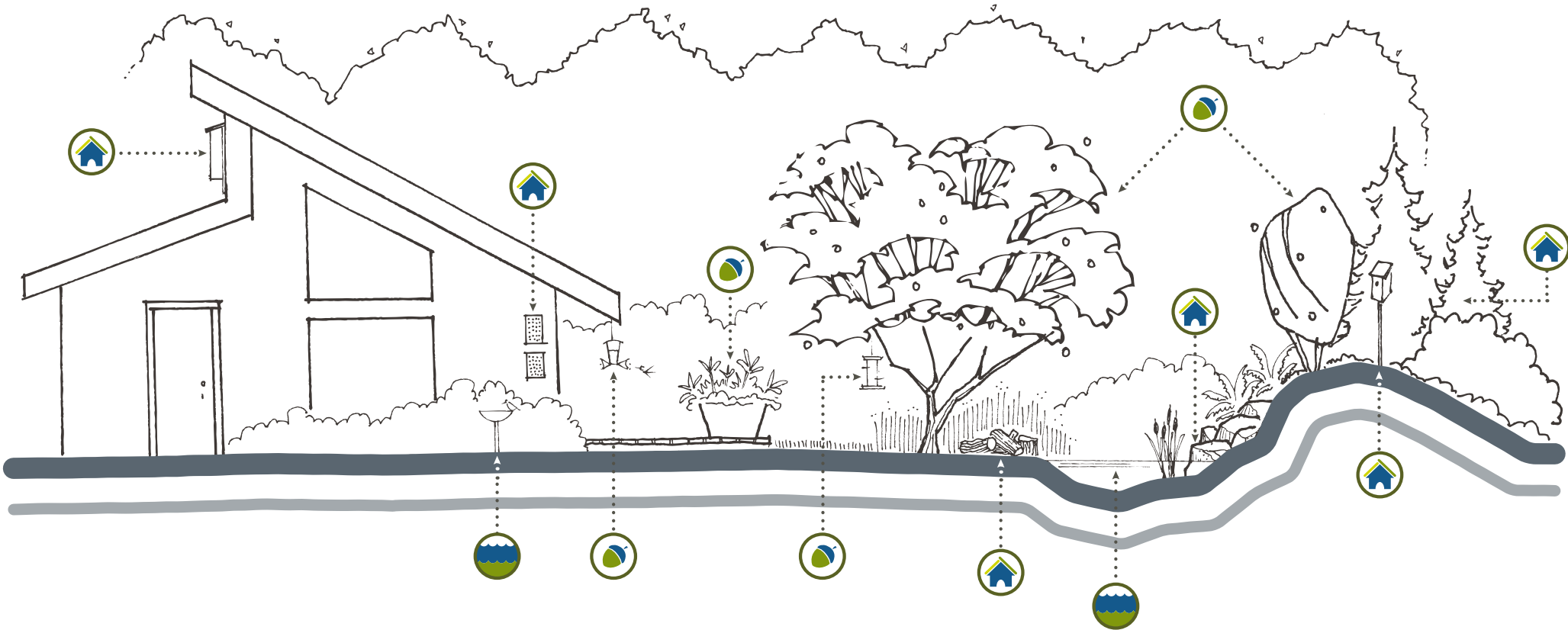
The City should actively encourage citizens to engage in naturescaping, particularly those living in homes adjacent to the GIN, sensitive watercourses, and other natural areas. Many resources are available to assist residents with naturescaping. The City distributes a pamphlet entitled *“Backyard Habitats: Creating sanctuaries for you and local wildlife”*. The province published *“Naturescape British Columbia: The Provincial Guide”* (BC Ministry of Environment, Lands and Parks 2003). Naturescape BC is a program that provides additional resources to assist local homeowners plan for backyard biodiversity. A backyard biodiversity program can help encourage uptake of these initiatives on private land. The City should advertise best management practices and consider homeowner grants for their implementation.



ARTIFICIAL HABITAT	NATURAL HABITAT	FOOD SECURITY	GREEN INFRASTRUCTURE	WATER SUSTAINABILITY
Nest boxes Bat boxes Beehives/boxes Bird baths Planters	Backyard trees/ shrubs/herbs Flower/rock gardens Balcony boxes Boulevard trees/ landscaping* Backyard ponds Logs Rock piles	Fruit and nut bearing trees Backyard gardens Community gardens*	Green roofs/walls Green courtyards Artificial wetlands* Bioswales* Rain gardens Permeable pavement* Stormwater tree filter systems*	Greywater re-use Rainwater harvesting (e.g. rainbarrels) Xeriscaping (e.g. drought tolerant plants)

Table 13: Biodiversity Features for the Urban Matrix. * City initiatives

Backyard Biodiversity



Planning for habitat in the urban matrix should include features, either natural or artificial, that will support the three basic needs of wildlife:

- Shelter
- Food
- Water

Indigenous plants should be used where possible. These plants are adapted to local conditions and generally require

less maintenance. Ground cover (logs, rock piles, dense shrubs) provide important refuge areas for wildlife. Artificial habitat such as nesting boxes and bee hives can provide great benefit; however they do require maintenance. In developed areas, access to water can be scarce. Provision of a water feature is very important. This can be as simple as a bird bath. Consideration should be given to reducing unwanted conflicts with wildlife. This includes control of pets (cats/dogs), reducing bird-window collisions and managing waste to discourage pests and vermin.



Engineered Habitat Features

Other opportunities within the Urban Matrix to support the GIN include implementation of constructed features that mimic natural habitat and functions. Examples include bioswales, constructed wetlands, stormwater detention ponds, rain gardens, green streets, permeable pavement, green roofs and walls. Many of these features replace conventional grey infrastructure (e.g. pipes, culverts, pavement) and reduce the amount of hard surface on a landscape. Surrey's Integrated Stormwater Management Plan supports the use of many of these strategies, alternatively known as Low Impact Design (LID).

Integration of these features should continue to be encouraged when replacing aging infrastructure and re-developing streetscapes. Engineered habitat should also be considered at the development permit stage of larger projects. Cumulatively, these features contribute to support biodiversity in highly urbanized areas where it is not possible to protect larger areas of natural habitat.



BIOSWALES/RAIN GARDENS	STORMWATER DETENTION PONDS	GREEN STREETS	CONTAINER PLANTING	GREEN ROOFS AND WALLS
<p>Planted depressions that allow rainwater from urban areas to infiltrate naturally into the ground.</p>	<p>Collection areas for stormwater that allow sediments and other urban contaminants to settle and filter out. Planted, open water ponds provide valuable habitat and for a variety of species.</p>	<p>Individual and rows of trees and shrubs along streets provide important habitat connectivity through the urban matrix. Trees provide numerous other benefits such as air filtration, stormwater mitigation, energy savings, and improved streetscape aesthetics.</p>	<p>Small gardens that break up paved environments; they are often incorporated into parking lots, traffic circles and street bump outs. Collectively these small gardens can provide important habitat to insect and bird populations.</p>	<p>Specially designed walls and roofs that can support vegetation. In dense urban environments, these features are often the only opportunities to increase vegetation cover and provide important connectivity for birds and insects.</p> <p><i>Semiahmoo Library is home of North America's largest green wall. Photo by www.flickr.com/photos/curioustangles/</i></p>



Bald Eagle Nest in BC Hydro Transmission Tower - Hwy #99 near the Serpentine River

Managing Biodiversity at the Site Level

The Green Infrastructure Network is a landscape level strategy to protect core habitat areas and to restore and enhance connectivity. Natural areas also require management at the site level to restore and enhance degraded habitat that can support a

wide range of species. Table 14 provides a list of habitat features known to enhance biodiversity.

A comprehensive list of site specific recommendations is provided in *Surrey's Natural Areas Management Strategy* (located on the City's website). These

recommendations support the objectives of this *Biodiversity Conservation Strategy* and should be adapted in all natural areas. Below is a summary of site level recommendations that will help maximize biodiversity in both the GIN and the urban matrix.

RESTORATION OF DISTURBED HABITAT

There are numerous types of human and natural disturbance that can degrade habitat and cause environmental damage in urban areas. Some examples of human disturbance include land encroachment into natural areas, vandalism, dumping of waste, pets and pollution (e.g. noise, light, air). Natural disturbances include insect and pest outbreaks, windthrow, landslides and spread of invasive species.

Restoration and enhancement of degraded natural areas can be challenging. The City should develop a standardized restoration approach for natural areas that mimics natural succession. The objective is to establish viable, native plant communities in an ecologically sound, sustainable,

RECOMMENDATIONS FOR THE MANAGEMENT OF DISTURBED SITES

Establish a methodology for inventorying disturbed sites once identified. This assessment should include a risk rating, prioritization for restoration and recommendations for mitigation. The areas should be spatially identified and the information tracked in a GIS database;

Restoration prescriptions should follow a pioneer succession restoration strategy such as those outlined in the City of Surrey Restoration Prescriptions for Municipal Ponds and Riparian Systems.

and cost-effective way. Surrey's *Restoration Prescriptions for Municipal Ponds and Riparian Systems* is a good model that can be expanded on for all natural areas.

HABITAT FEATURE	CHARACTERISTICS
Wildlife trees	Live large trees or standing dead trees that provide critical habitat for nest cavities, nest platforms, dens, roosts, hunting perches and foraging sites.
Large coarse woody debris	Large woody material on the forest floor. In various stages of decay. Creates microclimates and provides cover and movement corridors.
Understory plant diversity	Different plants and trees provide species specific forage opportunities. Density of ground cover promotes habitat and protection of feeding and reproduction.
Canopy gaps and vertical structure	Canopy gaps allow light to reach the forest floor promoting diversity and dense ground vegetation. Vertical structure refers to the vegetation layers of the forest canopy. Multi-layered stands have trees of different species, size and age that provide cover and nesting opportunities for a multitude of species.
Aquatic/wetland habitat	Access to water is critical for the survival of all wildlife species. Moving and still open water as well as wetlands provide habitat that is critical for the survival of many species.

Table 14 - Site level features of habitats that support high levels of biodiversity



Malacosoma sp
Tent caterpillars



Hedera helix - English Ivy

INVASIVE SPECIES MANAGEMENT

Introduced species are micro-organisms, plants, mammals, birds, reptiles and insects found outside of their natural range. These organisms can outcompete native species and have the potential to cause significant economic and environmental damage. In

these instances, they are referred to as being invasive. The World Conservation Union (IUCN) states that invasive species are one of the most significant threats, after habitat loss, to biodiversity on the planet (IUCN, 2009). Management of invasive species is important because they

have the ability to establish quickly and spread rapidly causing devastating impacts on ecosystem dynamics. Invasive plant species of greatest concern include aggressive species that can displace native plant species.



Rubus discolor - Himalayan blackberry



Rana catesbeiana - American bullfrog



Heracleum mantegazzianum - giant hogweed

RECOMMENDATIONS FOR THE MANAGEMENT OF INVASIVE SPECIES

Complete a comprehensive invasive species management strategy that includes plants, animals and insects; consider new species that may arrive due to climate change;

Maintain a spatial inventory of invasive species in all natural areas;

Prioritize efforts to control invasive species at a local level to those areas with sensitive ecosystems and rare plant communities;

Quarantine soils removed from development sites that are contaminated with noxious weeds;

Co-operate with the Canadian Food and Inspection Agency to monitor for invasive insect species;

Adopt or create a notification system for the public to report invasive plant and animal species;

Install preventative structures (fencing, ditches) to prohibit dumping of garbage and gardens waste;

Increase the fines and enforce penalties for dumping of waste in natural areas.

Table 15 - Recommendations for the management of invasive species



Mud Bay Park

FORESTED HABITAT

Surrey has a high percentage of young forest. Young forests lack many of the habitat characteristics associated with older forests. For example, mature forests generally have more tree and plant species, a more structurally diverse tree canopy, larger trees, and an abundance of wildlife trees and large, coarse woody debris. Younger forests will develop these characteristics over time through forest succession, however the process is slow. Strategies can be implemented to help speed the process of succession and create these features.

SHRUB/HERB/GRASS HABITAT

Shrub-herb-grass habitats are important contributors to biodiversity. These non-forested ecosystems have a diversity of wildlife, including small mammals, which in turn support predators such as raptors, Great Blue Herons and coyotes. Shrub-herb-grass dominated ecosystems are found naturally on wetland and intertidal ecosystems. In Surrey, many shrub and grassland communities are created and maintained by humans. Agricultural fields, landscaped

areas, utility rights-of-way and parkland managed as old field are examples. When these habitats are not maintained, they are often quickly colonized by pioneer tree species (e.g. red alder). In addition, more intensive cultivation and industrialization of agriculture land to increase productivity can reduce the amount of habitat. Invasive plant species, such as Himalayan blackberry, can prevent germination and establishment of native plant species and reduce biodiversity.

RECOMMENDATIONS FOR FORESTED ECOSYSTEMS
<p>Encourage the creation of wildlife trees in natural areas. Prioritize the retention of conifer species that are >30cm in diameter. Retain a height that is 2/3 the distance to the nearest target;</p> <p>Establish interconnected large coarse woody debris on the ground;</p> <p>Under plant deciduous dominated stands with secondary succession conifer species such as spruce, western redcedar, western hemlock and grand fir;</p> <p>Underplant even aged, single canopied stands less than 100 stems/ha with secondary succession conifer species;</p> <p>Create small canopy gaps to enhance structural diversity and promote the development of ground cover in dense even aged stands;</p> <p>Install nest boxes in areas that have few wildlife trees.</p>

Table 16 - Recommendations for forested ecosystems

RECOMMENDATIONS FOR THE ENHANCEMENT OF SHRUB/HERB/GRASS HABITAT		
HERB AND GRASS ECOSYSTEMS ENHANCEMENT	SHRUB COMMUNITIES	UTILITY RIGHT-OF-WAYS
<p>Implement periodic mowing schedules in grass and shrub communities to support biodiversity (small mammals and ground nesting birds);</p> <p>Install raptor perches and consider planting artificial wildlife trees;</p> <p>Plant hedgerows to provide movement cover for small and medium size mammals ;</p> <p>Establish small patches of trees in and adjacent to shrub-old field habitat;</p> <p>Create wetland communities along the edges of old field habitat;</p> <p>Identify priority sites for blackberry removal;</p> <p>Create islands/piles of large woody debris.</p>	<p>Identify priority sites for blackberry removal and maintain old-field habitat;</p> <p>Promote natural shrub communities in areas that cannot support trees (e.g. utility right-of-ways).</p>	<p>Establish wetlands and ponds in strategic locations;</p> <p>Establish 50% natural shrub cover for wildlife;</p> <p>Created corridor elements using hedgerows and CWD;</p> <p>Install wildlife trees</p>

Table 17 - Recommendations for the enhancement of shrub/herb/grass habitat



Nikomekl River

AQUATIC HABITAT

The City's watercourses provide habitat for a variety of aquatic organisms, including the five species of Pacific salmon, steelhead, cutthroat trout and numerous other freshwater fish species. These habitats also support a great diversity of aquatic and benthic invertebrates and herpetofauna, including frogs and salamanders. Numerous other wildlife species also make use of watercourses and their associated riparian areas to supply some or all of their life requisite needs.

Wetlands are valuable natural ecosystems that provide a variety of important functions. In addition to acting as a natural filter they provide free ecosystem services such as flood attenuation, moderation of drought and climate change effects, carbon sequestration and provision of

wildlife habitat. Urban development over the past century has degraded many aquatic and riparian habitats. Many of the City's most important streams have been dyked to manage for flooding. Opportunities to create new wetlands should be pursued when planning stormwater management.

There are opportunities to restore and enhance fish habitat with the City; however, these projects require careful planning, must comply with legislation and often require approval from federal and provincial governments. These projects usually must be carried out under approved timing windows and require ongoing monitoring to determine their success. A prioritized list of in-stream enhancement projects should be developed. This list will help the City to capitalize on future funding opportunities as they become available.

RECOMMENDATIONS FOR AQUATIC HABITAT

STREAMS

Identify factors and habitat features that are limiting fish populations;

Remove barriers to fish movement;

Enhance reaches with poor instream habitat diversity. Including large woody debris structures, pools and side channels;

Inventory and maximize the quality of salmonid spawning habitat;

Continue to carry out water quality monitoring for all red coded stream systems;

Minimize recreation trail creek crossings. Where necessary, ensure fencing to prohibit access to the water;

Ensure fish passage through all infrastructure crossings of red coded creeks during redevelopment;

Pursue opportunities to daylight watercourses.

WETLANDS AND PONDS

Encourage retention and integration of existing wetlands into new development;

Protect a 30m riparian terrestrial buffer around all wetlands and ponds;

Protect wetlands in policy ensuring no net loss during development;

Create new wetlands when possible as part of stormwater management;

Work with golf courses to expand wetland communities;

Inventory and remove invasive plant species from wetlands and ponds;

Monitor and manage invasive wildlife (ie. Bullfrogs, Carp);

Create naturalized islands in larger wetlands/ponds for wildlife refuge;

Promote the installation and maintenance of bird boxes.

Table 18 - Recommendations for aquatic habitat

RECOMMENDATIONS FOR RIPARIAN HABITAT

Implement pioneer succession restoration strategies outlined in the City of Surrey Restoration Prescriptions for Municipal Ponds and Riparian Systems;

Enforce Streamside Protection and Enhancement Areas (SPEA) setbacks from top of bank for Class A & B watercourses;

Re-establish required setback distance and restore natural habitat for SPEAs as a condition of re-development;

Identify opportunities to introduce vegetation within the riparian areas of dyked river systems;

Work with golf courses to ensure minimum 10m riparian buffer from all red coded creeks and a minimum of 50% of wetland perimeter is naturalized; naturalization of south banks is a priority for creek shading.

Where tree and plant species diversity is low, develop planting plans to protect and improve ecological integrity of SPEAs;

Encourage the creation of wildlife trees in riparian areas. Prioritize the retention of conifer species that are >30cm in diameter. Retain a height that is 2/3 the distance to the nearest target;

Increase cover and connectivity of large woody debris to provide ground cover corridors;

Promote lower canopy and shrub cover within 10m of creeks;

Locate recreation trails and facilities on only one side of riparian corridors. Trails should be outside the Streamside Protection and Enhancement Area and at a minimum distance of 10m above the top of bank for ravines;

Inventory and remove invasive plant species from riparian areas. Prioritize their removal based on their risk to the integrity of the ecosystem (ie – knotweed);

Install fencing between trails and creeks where dogs and humans continue to access the creek;

Riparian communities associated with red coded ditches should be naturalized with at minimum a shrub community.



Beaver Lodge, Blackie Spit Park

RIPARIAN HABITAT

Protection and enhancement of riparian plant communities will help maintain water quality and support aquatic and terrestrial species that depend on this habitat. Riparian vegetation moderates water and soil temperatures by

providing shade. Trees and shrubs also help stabilize banks. Litter and coarse woody debris that falls into waterways contributes additional food, nutrients and cover for aquatic organisms.

Table 19 - Recommendations for riparian habitat



Agricultural land.



Intertidal salt marsh.



Unmanaged shrubs.



Young deciduous trees.



Rana aurora - Red-legged Frog

Species at Risk

Species and ecosystems may be at risk for several reasons; however, habitat loss is considered to be the number one factor. Some of British Columbia's most endangered ecosystems are ones where people have settled and developed. Urban areas pose particular challenges due to the limited availability and degraded condition of existing habitat, in addition to continued development pressure. Wildlife that either cannot adapt to these changes, or are not considered compatible with human activity, is displaced over time.

The BC government maintains a list of species and ecosystems at risk. Ecological communities, and indigenous species and subspecies that are extirpated, endangered, or threatened are placed on the Red-list. The Blue-list contains ecological communities, and indigenous species and subspecies considered to be of special concern. Wildlife designated as Red or Blue-listed may be considered for further protection under the provincial *Wildlife Act* [RSBC 1996] or under federal endangered species legislation. Management plans are then developed and implemented. Ecosystems at risk have no special protection under current legislation.

Some species at risk in British Columbia are common in adjacent jurisdictions. Species whose northerly range limits extends into southern British Columbia is an example. It is likely that with continued climate change and northerly expansion of range, some of these species (in addition to new ones) will become more common and have more robust populations in the province. Therefore, it is imperative that the importance of a particular habitat type is not devalued if it does not currently support species at risk. Rather, it is the potential of a particular habitat to support a variety of species that should be considered.

Species management strategies should be developed for species that are regionally at risk. A species' range should also be considered in its entirety, regardless of jurisdictional boundaries. These strategies should provide clear direction for management requirements on private property. On City owned lands, it is recommended that species at risk recovery strategies developed by the Committee on the Status of Endangered Wildlife in Canada be adopted.

Biodiversity Policy



The City of Surrey has two guiding policy documents: the *Official Community Plan (OCP)* and the *Sustainability Charter*. These documents provide a vision for sustainable development and give direction as to how it can be achieved. Much of the language in the OCP and the *Sustainability Charter* reflects the growing emphasis the City is placing on environmental protection, biodiversity, green infrastructure and sustainable development. The recommendations in this Strategy support those initiatives. Although the recommendations focus on biodiversity, many also relate to building and site design, infrastructure, recreation, food production, climate change, and human health. The goal is to emphasize the important interrelationship between biodiversity and sustainability. Many of the policies recommended in this document have been implemented in other jurisdictions. Other policies build on work conducted by leading national and international agencies and have been adapted to the City of Surrey. Well designed policies provide certainty for developers, flexibility to adapt to changing conditions, and maintain vital ecosystem processes. Policies are intended to preserve Surrey's biodiversity and support long-term sustainability.

Habitat protection is essential to preserve biodiversity. The Green Infrastructure Network includes priority habitat on public and private land. Designating land as part of a GIN alone will not maintain baseline biodiversity levels in the City. Additional protection is required to support the GIN network. An Environmental Development Permit Area (DPA) designation will complement the GIN by establishing

regulatory requirements to guide development in ecologically sensitive areas, including riparian areas and land within and adjacent to the GIN.

- Development near the Green Infrastructure Network within and adjacent to Green Infrastructure Network to ensure proposed development recognizes important ecological values and supports biodiversity conservation objectives. This DPA also recognizes the enhanced livability and desirability of neighbourhoods situated next to protected natural areas. Developers will be required to meet specified biodiversity targets. Opportunities to implement alternative development models (e.g. cluster housing, conservation subdivision design) and other incentives to preserve natural area will be explored.
- Riparian Areas – The Environmental DPA will include all Class A, A(O), and B watercourses outside of the GIN and the Agriculture Land Reserve. This DPA recognizes the importance and ecological sensitivity of the City's watercourses and protects water quality, riparian habitat and slope stability. Development within Riparian DPAs will be required to meet specified biodiversity targets.

Policy recommendations to support biodiversity are separated into categories. Many of these support and build on existing policy, including the OCP, the Sustainability Charter, and Integrated Stormwater Management Plans.

Policy recommendations to support biodiversity are separated into categories. Many of these support and build on existing policy, including the OCP, the Sustainability Charter and Integrated Stormwater Management Plans.

A. PLANNING AND DEVELOPMENT

Objective: Consider and incorporate biodiversity initiatives through all levels of the City’s planning and development framework

A-1 BIODIVERSITY CONSERVATION STRATEGY IMPLEMENTATION

NUMBER	RECOMMENDATION
A-1.1	Integrate recommendations of the <i>Biodiversity Conservation Strategy</i> into the Official Community Plan and other relevant documents;
A-1.2	Review and track the implementation of the GIN every two years as a part of the Sustainability Dashboard;
A-1.3	Work with neighbouring municipal partners and provincial and federal agencies to support biodiversity initiatives;
A-1.4	Provide sufficient resources and staffing to support City biodiversity initiatives;
A-1.5	Develop training programs in relevant municipal departments to raise awareness of new biodiversity objectives;
A-1.6	Ensure interagency and interdepartmental cooperation to implement biodiversity initiatives;
A-1.7	Create and maintain a biodiversity database which should include habitat mapping and population surveys of identified indicator species to monitor change over time; Host an annual “bioblitz” to develop this database; Develop a bird monitoring program in coordination with community volunteers that integrates annual Christmas Bird Count data and a Summer Bird Count;
A-1.8	Update the City’s Sustainability Dashboard to include biodiversity performance indicators and targets;
A-1.9	Incorporate the United Nations’ City Biodiversity Index (when completed) to provide a global comparison of Surrey’s biodiversity efforts;

Table 20. Biodiversity Conservation Strategy Implementation Policy

A-2 DEVELOPMENT PLANNING, OPPORTUNITIES, PERMIT AREAS AND MONITORING

NUMBER	RECOMMENDATION
A-2.1	Review all development applications to ensure they meet the objectives of the Biodiversity Management Area;
A-2.2	Establish a Riparian Development Permit Area (DPA) for all Class A, A(0) and B watercourses outside of the ALR to protect biodiversity, water quality and slope stability. Width of DPA will include the watercourse, riparian area and extend to 50 metres from the top of bank. All properties including all or a portion of the Riparian DPA will be subject to the DPA guidelines. Any development within the Riparian DPA area requires a Qualified Environmental Professional (QEP) to assess and prescribe management that will meet the objectives of the Biodiversity Conservation Strategy;
A-2.3	Enforce minimum Streamside Protection and Enhancement Areas (SPEA) setbacks from top of bank for Class A, A(0) and B watercourses; disturbed areas within SPEAs must be restored as a condition of development;
A-2.4	Establish an Environmental DPA to protect the ecological integrity of the Green Infrastructure Network (GIN). The DPA will include all GIN areas (hubs, sites and corridors) and extend 50 metres from the edge of GIN. All properties including all or a portion of the Environmental DPA will be subject to the DPA guidelines. Any development within the Environmental DPA area requires a Qualified Environmental Professional (QEP) to assess and prescribe management that will meet the objectives of the Biodiversity Strategy;
A-2.5	Enforce appropriate development and building timing windows for fish and wildlife. Tree clearing should be avoided during the bird nesting season. Work in and around watercourses should respect fish timing windows developed by the BC Ministry of Environment;
A-2.6	Consider incentives to increase density and encourage alternative development approaches (e.g. cluster housing, Conservation Subdivision Design) to retain natural areas and enhance buffer zones adjacent to the GIN;
A-2.7	Implement measures to improve wildlife crossings within the GIN network to facilitate movement and reduce traffic mortality;
A-2.8	Consider incentives to restore degraded habitat during re-development;

A-2.9	Establish canopy cover targets for different land uses that will contribute towards the City wide goal of 40%;
A-2.10	Update the definition of “protected tree” as stated in the City of Surrey Tree Bylaw to include all trees in the GIN and SPEAs;
A-2.11	Continue to support the Tree Voucher Program to increase tree cover on private property;
A-2.12	Update the Tree Bylaw to enhance protection and replacement criteria for all healthy single stemmed conifer trees with a diameter greater than 100 cm measured at 1.4m above the ground;

Table 21. Development Planning, Opportunities, Permit Areas and Monitoring Policy

A-3 NATURAL AREAS ACQUISITION, PROTECTION AND ENHANCEMENT

NUMBER	RECOMMENDATION
A-3.1	Designate appropriate City-owned land within the GIN as protected;
A-3.2	Identify priority natural areas for acquisition as part of GIN;
A-3.3	Identify opportunities to sell City-owned land outside of the GIN and acquire higher priority land that can be integrated into GIN;
A-3.4	Explore options to implement transfer or purchase of Development Rights for natural areas acquisition;
A-3.5	Work with land trusts and private landholders to establish voluntary conservation easements on private land;
A-3.6	Pursue land contribution, cash in lieu and/or a residential Green Infrastructure Levy to acquire land that contributes to or enhances the GIN;
A-3.7	Consider a Green Tax and adjusting Area and City Wide DCC's to assist in the natural areas acquisitions. Consider applying parkland dedication requirements on Commercial/Industrial/Institutional development.
A-3.8	Lobby senior levels of government to review the applicable legislation for Parkland Dedication and DCC's pursuant to natural areas protection;
A-3.9	Promote biodiversity and environmental protection incentives for golf courses and cemeteries. Encourage environmental certification by international agencies, such as the Audubon Cooperative Sanctuary Program for Golf;

Table 22. Natural Areas Acquisition, Protection and Enhancement Policy

A-4 GREEN BUILDING STANDARDS

NUMBER	RECOMMENDATION
A-4.1	Explore incentives for and encourage developers to integrate natural biodiversity features (e.g. trees, wetlands) into development; Incorporate a Biodiversity Checklist (Appendix G) that will require developers to achieve a specified biodiversity target, but permit flexibility in how this can be achieved.
A-4.2	Adopt the Sustainable Sites Initiative (SSI) for development of publicly owned lands. Provide incentives to private land owners for meeting these voluntary standards;
A-4.3	Maintain an updated list of recognized invasive plant species and prohibit them from use in all development landscaping;
A-4.4	Incorporate targets for biodiversity such as tree cover, naturoscaping and wildlife movement into applicable City Standards and Guidelines related to landscaping;
A-4.5	Provided targets for development to incorporate a minimum representation of biodiversity friendly flora for landscaping;
A-4.6	Encourage use and implementation of natural drainage patterns, naturoscaping, green infrastructure, permeable surfaces, sustainable drainage features, and Low Impact Development (LID) to manage stormwater and support biodiversity objectives;
A-4.7	Naturalize existing and proposed stormwater detention ponds where possible to enhance habitat value; ensure a naturalized terrestrial buffer; Encourage creation of small wetlands associated with open drainage features;
A-4.8	Promote improved design of parking lots on public and private property that create more opportunities for biodiversity including open, planted swales and trees with larger canopy coverage;

NUMBER	RECOMMENDATION
A-4.9	Promote salvage of native plants and topsoil from greenfield development sites for use in restoration and enhancement projects to support genetic diversity and local seed sources;
A-4.10	Provide incentives to adopt green roofs and walls in new industrial, commercial and residential development;
A-4.11	Implement biodiversity strategies for active parks. Include hedgerows and canopy cover guidelines for playfields, parking lots and landscaped areas;
A-4.12	Minimize light pollution in Environmental DPA areas;

Table 23. Green Building Standards Policy

B. AGRICULTURAL AREAS

Objective: Enhance biodiversity on ALR through habitat protection and enhancement and sustainable agricultural practices

B-1. AGRICULTURAL BIODIVERSITY

NUMBER	RECOMMENDATION
B-1.1	Work with farming community to encourage sustainable farming practices that support food production and provide free ecosystem services (i.e. crop diversity, habitat, carbon sequestration, flood risk mitigation);
B-1.2	Work with local farmers and conservationists to find ways to improve stewardship on agricultural land. Integrate and coordinate with existing agricultural programs such as the Environmental Farm Plan, Code of Agricultural Practice, Agricultural Building Setback Standards, Delta Farmland & Wildlife Trust;
B-1.4	Encourage farmers to establish and protect riparian buffers on agricultural land that consider flood return levels;
B-1.5	Work with farm community to sustainably manage temporal and geographic distribution of fallow fields to support biodiversity, particularly migratory birds;
B-1.6	Investigate potential to enhance dykelands with natural vegetation (trees, shrubs) in riparian areas adjacent to Nikomekl and Serpentine Rivers, while recognizing provincial guidelines and dyke maintenance requirements;
B-1.7	Protect integrity of existing dykes; however, explore opportunities to widen the channel for re-vegetation and habitat enhancement;
B-1.8	Explore incentives for private land holders to retain forest and natural habitat on non-arable land;
B-1.9	Ensure windfirm forested and landscape buffers adjacent to the ALR boundary;
B-1.10	Encourage hedgerows, where appropriate, adjacent to fields and row crops;
B-1.11	Ensure that fencing in and around agricultural areas allows for wildlife passage in key areas;
B-1.12	Develop an outreach program that teaches ecological design principles for field drainage systems and ponds. Work with farmers to retain, enhance and create wetlands in areas prone to seasonal flooding;
B-1.13	Identify and protect key groundwater recharge areas, and aquifers that contribute groundwater to open channels during the summer;
B-1.14	Encourage governing agencies to investigate water licenses for agricultural irrigation and livestock and how this may affect the local stream ecology;
B-1.15	Implement a program to support increased native bee production and pollination;
B-1.16	Work with local farmers to restrict livestock access to natural watercourses;

Table 24. Agricultural Biodiversity Policy

C. CLIMATE CHANGE

Objective: Improve ecosystem resilience to anticipated effects of climate change by adapting to changing ecological conditions

C.1 CLIMATE CHANGE AND BIODIVERSITY

NUMBER	RECOMMENDATION
C-1.1	Incorporate recommendations of City of Surrey Climate Change Adaptation Strategy to support resilient and healthy ecosystems;
C-1.2	Preserve and restore ecosystems as an integral component of the City's climate change mitigation and adaptation strategy, particularly with regard to carbon sequestration and floodwater management;
C-1.3	Model and manage for predicted impacts of sea level rise to coastal foreshore and floodplain areas;
C-1.4	Develop ecosystem-based adaptive strategies to manage for biodiversity and reduce dyke maintenance/construction costs associated with projected sea-level rise;
C-1.5	Develop biodiversity landscaping and planting guidelines to ensure trees and vegetation are adaptable to the changing climate;

Table 25. Climate Change and Biodiversity Policy

D. COMMUNITY EDUCATION AND AWARENESS

Objective: Increase awareness of local biodiversity and its importance for community sustainability

D.1 EDUCATION AND AWARENESS

NUMBER	RECOMMENDATION
D-1.1	Implement interpretive programs to support biodiversity including trail and park signage and informative displays;
D-1.2	Promote nature and biodiversity conservation programming at the Surrey Nature Centre at Green Timbers
D-1.3	Create and update a biodiversity webpage on City of Surrey site;
D-1.4	Support school and summer camp programs that encourage students to learn about biodiversity and experience Surrey's natural areas;
D-1.5	Initiate City workshops to teach residents about naturescaping and sustainable gardening to enhance biodiversity in the City;
D-1.6	Encourage community members to participate in the conservation of biodiversity through participation in events such as the monitoring program, bio-blitz, invasive species pulls etc.;
D-1.7	Inform and educate developers and landscapers of biodiversity conservation objectives;

Table 26. Community Education and Awareness Policy

Biodiversity Checklist

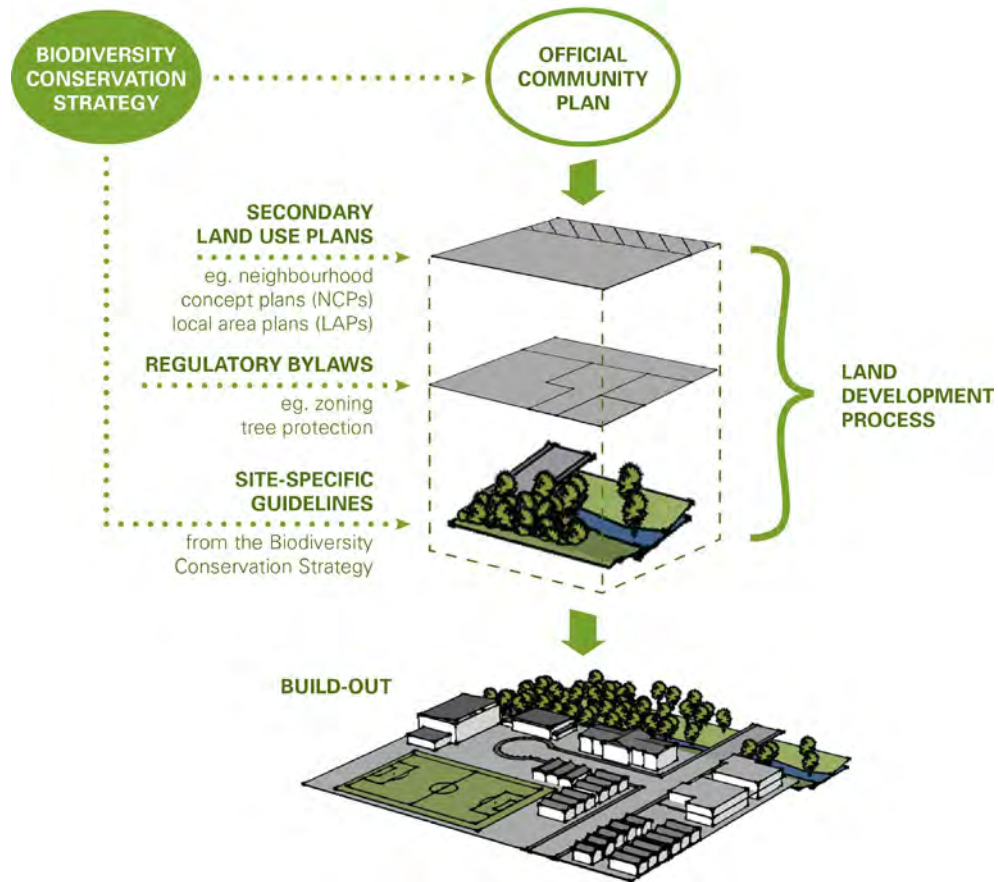


Ardea herodias - Great blue heron

The City of Surrey has developed a Sustainable Development Checklist (SDC) for planning and development applications. The Checklist raises awareness of the City's sustainability objectives and provides guidance for developers to achieve them. The Checklist focuses on aspects of riparian management, trees and natural areas, green infrastructure and rainwater management. The Sustainable Development Checklist is only intended as a guide, and does not require developers to meet specific targets.

A Biodiversity Checklist should be implemented to meet the City's biodiversity conservation objectives. The Biodiversity Checklist could be integrated into the current SDC to streamline implementation. Either way, the key to successful implementation is to require compliance (necessitating amendments to the zoning bylaw) or offer incentives. The checklist would require developers in designated zones to meet a specified standard (e.g. number of points) for biodiversity, but also allow some degree of flexibility in how this is achieved. Points are designated for different biodiversity features incorporated into the site and building design, weighted based on the 'quality' of the feature(s) and area covered.

This approach is being used successfully in Berlin, Germany, where it was first implemented in 1994. Since then, other jurisdictions have developed similar programs. Notably, the City of Seattle, Washington was awarded an Honour Award by the American Landscapers Association in 2010 for their "Green Factor" program. The Biodiversity Checklist is particularly suited to enhance local biodiversity at a site level, and to Development Permit Areas that support the Green Infrastructure Network. Case studies are provided in Appendix G to illustrate how a similar system can be applied in Surrey as part of a zoning bylaw update.



Implementation of the strategy

This BCS supports the City's overall sustainability and environmental management framework. Implementation of this strategy will require concurrent and future updates to other plans, strategies and bylaws to ensure objectives are consistent and management efficiencies are achieved. Table 27 highlights some key implementation objectives and expected outcomes of the BCS.

Figure 8: Role of the BCS within the City's land use planning process

OFFICIAL COMMUNITY PLAN (OCP)	SUSTAINABILITY CHARTER	SECONDARY LAND USE PLANS	PARKS, RECREATION, AND CULTURE STRATEGIC PLAN	OTHER PLANS, STRATEGIES, AND BYLAWS
<p>Replace current Environmentally Sensitive Area (ESA) mapping with Habitat Suitability Mapping</p> <p>Create and Amend Development Permit Areas (DPAs) to reflect GIN mapping and recommendations for biodiversity conservation</p>	<p>Update the City's Sustainability Dashboard and Monitoring to include biodiversity performance indicators</p>	<p>Refer to BCS to assess and streamline the Environmental Assessment process and guide land use planning and development</p>	<p>Update Parks Acquisition and Prioritization plan based on BCS recommendations</p> <p>Incorporate BCS recommendations into updated Natural Areas Management Plan</p>	<p>Integrate Biodiversity Checklist with Sustainability Development Checklist</p> <p>Update Tree Protection Bylaw to reflect biodiversity and tree retention objectives in GIN and associated DPAs</p> <p>Consider biodiversity and green infrastructure objectives for future updates to Zoning Bylaw and Subdivision and Development Bylaw</p> <p>Integrate and coordinate with existing agricultural programs</p> <p>Incorporate recommendations of Climate Change Adaptation Strategy</p>

Table 27: Implementation Guide for the *Biodiversity Conservation Strategy*

Monitoring and Performance

A monitoring program provides a mechanism to detect changes in the environment (and biodiversity) over time. Ecological indicators can be identified to assist in this process. Early detection of environmental change can raise awareness of potential trends and provide time to implement adaptive management strategies. Monitoring can also be used to measure and evaluate management performance and progress towards achieving biodiversity objectives.

Ecological Indicators

Ecological indicators provide a measure of the current condition of an ecosystem (or its components). They are used to track environmental change, whether it is caused by human impacts to the environment or by natural occurrences (PALCO, 1999). Indicators are selected based on their ability to relay specific information that can be used for management purposes. For example, benthic invertebrates and amphibians are considered good ecological indicators due to their relatively high sensitivity to changes in water quality (e.g. pH, salinity, etc). Birds are particularly valuable as indicators due to ease of observation, responsiveness to change, and abundant

research to support their use. Birds also have an image that tends to resonate positively with many people. The United Kingdom includes bird population trends as one of their key indicators of 'Quality of Life' (BirdLife International, 2004).

Population health of other species and quality of habitat may be inferred, albeit cautiously, based on management information collected for ecological indicator species. Potential indicator species have been identified to monitor biodiversity and environmental change (see Appendix H for selection criteria). These species are easily monitored and are typical of the habitats found in Surrey. The health of these species populations should indicate the ecological health of a natural area.

One criteria for a good indicator species is that there is scientifically verifiable evidence that it would respond quickly enough to changes in habitat quality to provide an early warning of reduced habitat value. This ensures that a monitoring program should be developed that will include a scientific review of the recommended species. Ecological monitoring programs should be developed that provide a scientific review of target species and include detailed monitoring methods.

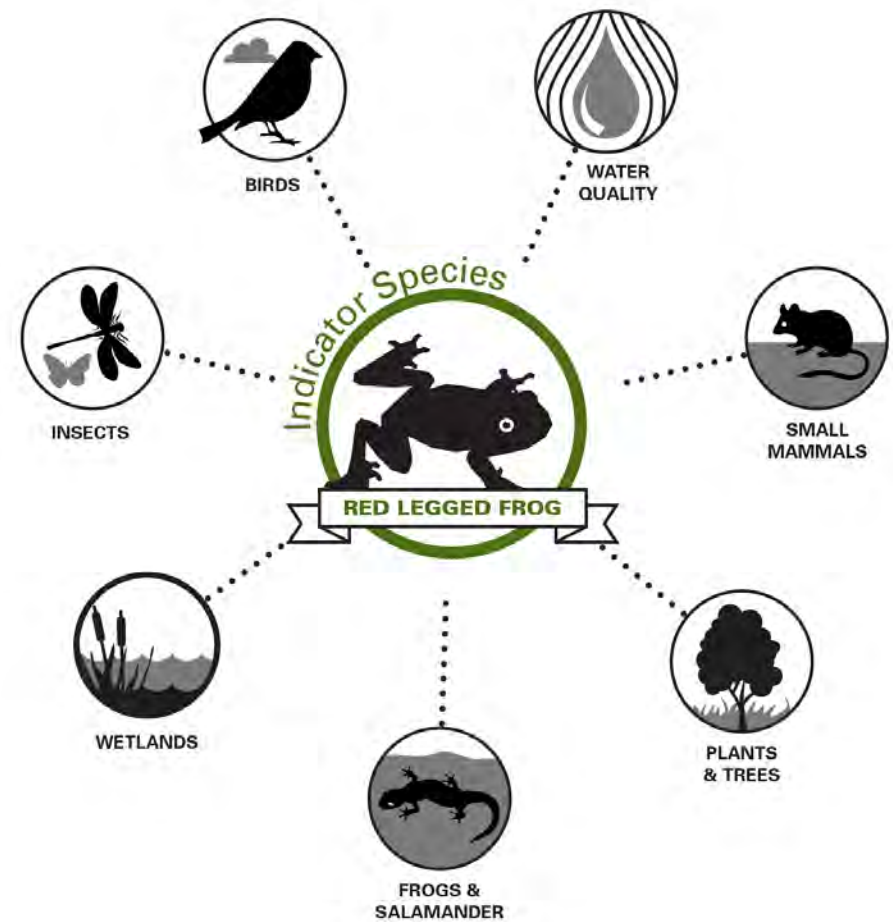


Figure 9: Indicator Species

INDICATOR SPECIES	AGRICULTURAL	INDUSTRIAL	SUBURBAN SOUTH	SUBURBAN NORTH	URBAN	SURVEY METHOD
MAMMALS						
Black-tailed Deer	•		•	•		Pellet groups
Douglas Squirrel	•		•	•		Visual survey
Mouse/Vole/shrew	•	•	•	•	•	Runway activity under cover boards
Muskrat	•		•	•		Burrows ,scat foraging sites
Townsend's Vole	•		•	•		Active runway density in field
BIRDS						
Common Yellowthroat	•					Singing birds
Dark-eyed Junco		•			•	Wintering numbers
Downy Woodpecker	•	•	•	•	•	Wintering numbers
Hooded Merganser	•		•	•		Wintering numbers
Northern Flicker				•		Wintering numbers
Pacific-slope Flycatcher	•		•	•		Singing birds
Red-tailed Hawk	•		•	•		Active Nests
Savannah Sparrow	•					Singing birds
Song Sparrow	•	•	•	•	•	Wintering numbers &/or singing birds
Spotted Towhee	•	•	•	•	•	Wintering numbers &/or singing birds
Swainson's Thrush	•			•		Singing birds
Warbling Vireo	•		•	•		Singing birds
Willow Flycatcher	•			•		Singing birds
Yellow Warbler	•		•	•		Singing birds
REPTILES/AMPHIBIANS						
Long-toed Salamander	•		•		•	Cover boards
Northern Pacific Treefrog	•	•	•		•	Singing/Calling
Northern Red-legged Frog	•			•		Egg masses
Northwestern Salamander		•			•	Egg masses
FISH						
Coho Salmon	•	•	•	•	•	Minnow Traps/Snorkel survey
Coastal Cutthroat Trout	•			•		Minnow Traps/Snorkel survey
INVERTEBRATES						
Dragonflies	•	•	•	•	•	Visual survey for adults
Moths and Butterflies	•	•	•	•	•	Visual survey for adults

Shrew sp, Mouse sp, Vole sp (named & unnamed in guild or indicator species lists): these indicators would be surveyed as a group using a single survey method that records only amount of combined activity.

Table 28. Indicator species by Management Class



Management Objectives, Criteria and Performance Indicators

The City of Surrey developed a list of sustainability indicators and targets to support the vision, goals and scope of the Sustainability Charter. Progress towards meeting these targets is tracked on the City's Sustainability Dashboard, which is an online tool designed to share this information with the community. Some of the goals support broad environmental pillars of the Sustainability Charter. However, additional measures are required to monitor and assess Surrey's progress towards meeting its own specific biodiversity management objectives. Many of these measures support and direct management action towards achieving key City objectives, such as implementation of the GIN or ensuring an effective policy framework is in place to support City initiatives. Others are based on those used in the United Nations' City Biodiversity Index (see Section 6.3), but include additional performance benchmarks.

Recommended Objectives, Criteria and Indicators are provided in Table 29. Some criteria are adopted from the Sustainability Charter and the City Biodiversity Index.

The *City Biodiversity Index* (CBI) was initiated in 2008 under the auspices of the UN Convention on Biological Diversity. The intent of the CBI is to help cities benchmark their biodiversity conservation efforts. The CBI will provide an international standard that the City can use to measure and compare its efforts to manage and conserve biodiversity. The CBI was designed to measure three distinct components:

- native biodiversity in the city,
- ecosystem services provided by biodiversity in the city, and
- governance and management of biodiversity in the city.

Numerous cities around the world are currently involved in testing the CBI. Although still in draft form (see Appendix I), the City should position itself as an early adopter of the CBI and participate in future programs to share information and evaluate its effectiveness. This program will provide an international comparison with other cities around the world.

KEY GOALS	ASSESSMENT CRITERIA	PERFORMANCE INDICATORS			
		LOW	MODERATE	GOOD	OPTIMAL
Encourage retention of Surrey's natural areas	Proportion of natural areas in City retained*	<10% of land base is retained as natural area	10-20% of land base is retained as natural area	20-30% of land base is retained as natural area	>30% of land base is retained as natural area
Establish and protect Green Infrastructure Network	Proportion of GIN protected	<30% of GIN is protected	30-60% of GIN is protected	60-90% of GIN is protected	>90% of GIN is protected
Increase biodiversity in built-up areas	Population of native bird species in built-up areas*	Population of native bird species at or below baseline (to be defined)	Population of native bird species <10% above baseline	Population of native bird species 10-20% above baseline	Population of native bird species >20% above baseline
Enhance and restore degraded natural areas	Development and implementation of habitat enhancement and restoration plans for degraded areas along GIN	Habitat and enhancement plans implemented for <30% of degraded areas along GIN	Habitat and enhancement plans implemented for 30-60% of degraded areas along GIN	Habitat and enhancement plans implemented for 60-90% of degraded areas along GIN	Habitat and enhancement plans implemented for >90% of degraded areas along GIN
Identify and protect species at risk	Management strategies and action plans for species at risk	Management strategies or action plans implemented for <30% of species at risk	Management strategies or action plans implemented for 30-60% of species at risk	Management strategies or action plans implemented for 60-90% of species at risk	Management strategies or action plans implemented for >90% of species at risk
Develop species inventory and monitor changes in biodiversity	Change in number of indicator species	Inventory and monitoring protocol developed and implemented for <25% of indicator species	Inventory and monitoring protocol developed and implemented for 25-50% of indicator species	Inventory and monitoring protocol developed and implemented for 50-75% indicator species	Inventory and monitoring protocol developed and implemented for >75% indicator species
Manage alien invasive species in natural areas	Proportion of invasive alien plant species compared to native plant species*	Proportion of alien plant species is >0.21	Proportion of alien plant species is 0.11-0.20	Proportion of alien plant species is 0.01-0.10	Proportion of alien plant species is <0.01
Reduce impermeable surface to regulate quantity of water	Proportion of permeable surface in City's terrestrial land*	City has <25% permeable surface (excluding agricultural land)	City has 25-50% permeable surface (excluding agricultural land)	City has 50-75% of permeable surface (excluding agricultural land)	City has >75% permeable surface (excluding agricultural land)
Increase tree canopy for climate regulation	Proportion of tree canopy cover*	City has <10% tree canopy cover (excluding agricultural land)	City has 10-25% tree canopy cover (excluding agricultural land)	City has 25-40% tree canopy cover (excluding agricultural land)	City has >40% tree canopy cover (excluding agricultural land)
Increase education and awareness of biodiversity issues in youth	Number of formal educational visits to natural park areas per child (<16 a) per year*	1 visit or less per year	2 visits per year	3 visits per year	4 visits per year
Increase education and awareness of biodiversity issues in youth	Inclusion of biodiversity related programs in educational institutions*	No programs exist or are being considered	Programs are being planned	Programs are being implemented	Programs exist
Increase public awareness of value of biodiversity	Implementation of outreach events/ programs and public awareness*	<60 events per year; little to no public awareness of issues	60-149 events per year; some local awareness of issues and management actions	150-300 events per year; local awareness of issues and management actions	>300 events per year; neighbourhood awareness of issues and management actions in natural areas

Table 29. Performance Indicators

KEY GOALS	ASSESSMENT CRITERIA	PERFORMANCE INDICATORS			
		LOW	MODERATE	GOOD	OPTIMAL
Increase budget allocation for biodiversity-related projects and administration	Number of biodiversity-related projects implemented annually by City*	No biodiversity-related projects initiated	1-5 biodiversity-related projects initiated	5-20 biodiversity-related projects initiated	>20 biodiversity-related projects initiated
Implement local biodiversity strategy and action plan	Implementation of Biodiversity Strategy*	No Biodiversity Strategy	Biodiversity Strategy developed	Biodiversity Strategy reviewed and updated semi-regularly to reflect conditions, goals and BMPs	Biodiversity Strategy regularly reviewed and updated to reflect conditions, goals and BMPs
Develop and implement an acquisition strategy for priority natural areas	Enactment of park acquisition strategy	No Acquisition strategy/Acquisition strategy developed with <30% of priority areas acquired	Acquisition strategy developed; 30-60% of priority areas acquired	Acquisition strategy developed; 60-90% of priority areas acquired	Acquisition strategy developed; >90% of priority areas acquired
Employ adequate staff to deliver comprehensive biodiversity program	Ability of staff to deliver comprehensive program	No staff or staff unable to deliver <30% of comprehensive program	Staff able to deliver 30-60% of comprehensive program	Staff able to deliver 60-90% of comprehensive program	Staff able to deliver >90% of comprehensive program
Develop and implement appropriate regulatory and enforcement mechanisms to support biodiversity management objectives	Implementation and enforcement of policy and bylaws	No policies or bylaws to manage biodiversity	Policies developed, with voluntary implementation, to manage biodiversity	Policies and bylaws implemented to support biodiversity management objectives	Regulatory and enforcement programs in place to support biodiversity management objectives
Improve interagency and regional cooperation for biodiversity management	Number of interagency and regional partnerships established*	0-6 interagency or regional partnerships established	7 – 12 interagency or regional partnerships established	13 – 19 interagency or regional partnerships established	20 or more interagency or regional partnerships established
Improve institutional capacity and cooperation for biodiversity management	Involvement of City and local government agencies in biodiversity management*	No cooperation in City administration to achieve common goals and objectives	Common goals and objectives are identified; minimal cooperation	Cooperation to achieve priority goals and objectives	Efficient management structure in place to coordinate to achieve common goals and objectives
Improve interagency and regional cooperation for biodiversity management	Regional cooperation with adjacent municipalities and Metro Vancouver	No integration or participation with regional biodiversity initiatives	Some participation in regional biodiversity initiatives	Cooperation with adjacent municipalities and Metro Vancouver to integrate regional biodiversity management initiatives	Full integration with regional biodiversity initiatives

Table 29. Goals, Assessment Criteria and Performance Indicators

* Criteria adopted from City Biodiversity Index

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Appendix B – Glossary



Agricultural Land Reserve (ALR): The Agricultural Land Reserve is a provincial zone in which agriculture is recognized as the priority use. Farming is encouraged and non-agricultural uses are controlled.

Biodiversity: Biodiversity is defined broadly as the variability of life on earth and the ecological processes that support it.

Cities and Biodiversity Outlook (CBO): The *Cities and Biodiversity Outlook* is a program focusing on the important relationship between urban areas and biodiversity. The *Cities and Biodiversity Outlook* has 10 key messages to guide sustainable urbanization and development.

Convention on Biological Diversity (CBD): The United Nation's Convention on Biological Diversity (CBD) is a landmark agreement that recognizes the global importance of biodiversity for human health, economic and social development and sustainability.

Ecological Footprint: The ecological footprint is a measure of human demand on the Earth's ecosystems. It represents the amount of biologically productive land and sea area necessary to supply the resources a human population consumes, and to absorb associated waste. (taken from Wikipedia)

Ecological Indicators: Ecological indicators provide a measure of the current condition of an ecosystem (or its components). They are used to track environmental change, whether it is caused by human impacts to the environment or by natural occurrences (PALCO, 1999).

Extirpated: is the condition of a species which no longer exists in the chosen geographic area of study, though it still exists in other places. Also known as local extinction.

Green Infrastructure Network (GIN): A GIN is an interconnected system of natural areas and open space that conserves ecosystems and functions, while providing benefits to both wildlife and people (Benedict and McMahon, 2006).

Habitat: Habitat is a broad term that refers to the environment that a species lives in and relies on to carry out its life cycle.

Habitat Capability: Habitat capability refers to an area's potential to support certain species if ecological conditions are improved.

Habitat Suitability: Habitat suitability refers to the current ecological characteristics of a specific area and its ability to support species, the species' life requirements, and the species' adaptability to changing conditions.

Hubs: Large natural areas over 10 hectares.

Island Biogeography: In this theory, larger habitat patches generally support greater biodiversity as compared to smaller patches. An "island" is any area of suitable habitat surrounded by an expanse of unsuitable habitat.

Keystone Species: Keystone species play a disproportionate ecological role relative to its abundance. These species maintain the structure of an ecological community, affecting many other organisms in an ecosystem and helping to determine the types and numbers of various other species in the community. (Wikipedia).

Naturescaping: A method of landscape design and landscaping that allows people and nature to coexist. (Wikipedia)

Pioneer Species: Species that tend to colonize a recently disturbed site. These are the first species to establish in natural succession.

Ramsar: The Convention on Wetlands of International Importance (known as the Ramsar Convention) is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. (www.ramsar.org)

Sites: Small patches less than 10 hectares.

Species Guild: Species Guild is defined as a biological community (group of higher-order organisms) is an effective approach to measuring and monitoring biodiversity.

Appendix C – Sustainability Charter Environmental Goals and Actions

ENVIRONMENTAL GOALS

To demonstrate good stewardship of the land, water, air and built environment, protecting, preserving and enhancing Surrey's natural areas and ecosystems for current and future generations while making nature accessible for all to enjoy.

1. Terrestrial Habitat and Life. Create a balance between the needs of Surrey's human population and the protection of terrestrial ecosystems, considering:

- a) Interconnecting Surrey and the areas outside Surrey through wildlife corridors, parks and natural areas;
- b) Protecting to the extent possible, existing urban forests and natural coverage, protecting trees and maximizing the city's tree canopy;

2. Water Quality/Aquatic Habitat and Life. Protect Surrey's ground water and aquatic ecosystems for current and future generations, considering:

- a) Surface runoff;
- b) Creeks, streams, and river systems;
- c) Sources of pollutants entering aquatic systems;
- d) Natural riparian systems; and Native ocean and freshwater habitats.

3. The Built Environment. Establish a built environment that is balanced with the City's role as a good steward of the environment:

- a) Minimize the impacts of development on the natural environment;
- b) Promote the use of native species and reducing the impact of invasive species;
- c) Incorporate opportunities for natural areas and urban wildlife;
- d) Protect unique and valuable land forms and habitats;

MUNICIPAL JURISDICTION SPHERE:

EN12: Enhancement and Protection of Natural Areas, Fish Habitat and Wildlife Habitat

Surrey's significant natural habitat areas support a wide range of plant and animal species and provide large valued green space and natural areas that not only provide natural habitat, but also provide buffers to urbanization and support low impact forms of recreation.

The City will support its natural areas by:

1. Undertaking an ecosystem Management study to update the City's mapping, policies and practices with regard to the identification, protection and management of environmentally sensitive areas using the ecosystem Management Approach;
2. Showing environmental leadership in the management, conservation and/or development of City-owned lands;
3. Undertaking remediation works in cases where unsustainable practices have been used in the past;

4. Maintaining and increasing the area of fish habitat and wildlife habitat in the City, in both established and newly developed areas; and
5. Continuing to protect and remediate existing natural areas and to acquire additional new natural areas.

INFLUENCING OTHERS SPHERE

EN17: Enhance Biodiversity

The City will advocate for sustainability in the areas of biodiversity, wildlife and fisheries by requesting additional tools and resources from senior levels of government, including:

1. Improved legislation for critical wildlife habitat protection;
2. Habitat management data, such as Sensitive Habitat Inventory Mapping (SHIM) and federal and provincial habitat and Species at Risk mapping;
3. Technical and financial assistance for habitat protection, potentially in partnership with private organizations and the community;
4. Practical, effective and equitable approaches to protect fish habitat and wildlife habitat;
5. A coordinated regional biodiversity strategy; and
6. Environmental monitoring resources to identify and manage areas of environmental concern as they emerge.

Appendix D – Regulations, Plans, By-laws

FEDERAL

Federal involvement in municipal affairs is limited due to constitutional provisions that give provinces jurisdiction over most matters. Some relevant exceptions include regulation of fisheries, species at risk, and migratory birds:

Migratory Birds Convention Act, 1994 (MBCA). Enacted to implement the *Migratory Birds Convention*, a treaty signed with the United States to protect listed bird species. The federal government has jurisdiction wherever listed birds occur.

Fisheries Act, 1985 Currently, the federal government has jurisdiction wherever fish and fish habitat occurs. Changes to the Act (effective November, 2013) focus protection rules on recreational, commercial, and Aboriginal fisheries. This protection also extends to fish that “support” these fisheries.

Species at Risk Act, 2002 (SARA). Includes provisions to help protect and manage threatened and endangered species and their critical habitat. The federal government’s jurisdiction is limited to federally owned lands; however, provisions in the Act require that provinces protect listed species to the standards of SARA.

Canadian Biodiversity Strategy (1995). Canada’s response to the Convention on Biological Diversity. Canada was an original signatory at the 1992 United Nations Conference on Environment and Development in Rio de Janeiro.

PROVINCIAL

The Province grants municipalities the authority to govern its own affairs and pass by-laws relating to its environmental, social and economic well-being. However, the province does maintain jurisdiction in some areas:

- **Fish Protection Act, 1997** and attendant **Riparian Areas Regulation, 2004 (RAR).** RAR was enacted to protect riparian habitat and maintain stream health and productivity. It requires municipalities to enact streamside protection provisions during development, using a meet-or-beat approach. Currently, Surrey requires corridor widths that are consistent with the DFO’s *Land Development Guidelines for the Protection of Aquatic Habitat*, which results in minimum setbacks depending on density and land use.

- **Water Act, 1996.** This Act manages uses of water (excluding groundwater) in the province. Section 9 of the Act specifically addresses changes in and about a stream. Currently, the province is updating the Act, and will eventually be replaced by a Water Sustainability Act.
- **Wildlife Act, 1996.** This Act provides for the protection and management of wildlife in British Columbia, including endangered and threatened species.
- **Local Government Act, 1996.** This Act outlines the powers and responsibilities of local governments. This includes implementation of land use regulations, development requirements, provisions for park land acquisition and designation of environmentally sensitive areas.
- **British Columbia Biodiversity Strategy.** A framework is currently being developed to prepare a Biodiversity Strategy for the province. This framework includes a report on the Status of Biodiversity (2008), a Biodiversity Atlas (2009) and other supporting material. Component reports address impacts to biodiversity, climate change, key and special elements, genetic diversity and First Nations.

REGIONAL/MUNICIPAL

Municipalities are granted authority by the Province to enact by-laws to address issues of local or regional importance. Many of these relate to land use planning, development and environmental sensitivity:

- **Metro Vancouver Regional Growth Strategy, 2011.** Provides direction for regional growth to 2040. Sustainability goals include environmental protection and climate change adaptation. The Strategy identifies key Conservation and Recreation areas and outlines regional, municipal, and provincial roles and actions necessary to achieve objectives.
- **Metro Vancouver Biodiversity Conservation Strategy.** This Partnership is developing an action plan to conserve biodiversity in the Region. The Plan will identify biodiversity “hotspots” and develop strategies towards a framework of corridors/greenways in Greater Vancouver. Work will guide and complement municipal initiatives to conserve biodiversity.
- **Metro Vancouver Regional Parks and Greenways Strategy, 2011.** A key regional sustainability plan that focuses on protection

of the natural environment, supporting public health, wellness and recreation and developing partnerships to acquire park land and operate regional parks.

- **Metro Vancouver Ecological Health Action Plan, 2011.** Emphasizes benefits of ecological services provided by intact, natural ecosystems. Key opportunities to improve regional ecological health were identified, including development of green infrastructure, supporting salmon in urban areas, supplementing ecosystem services and reducing toxins. Proposes 12 regional projects that can be implemented over the short term to support ecological health in the region.
 - **Surrey Official Community Plan (OCP), 2002.** The OCP provides general objectives, policies and guidance for future planning and development in the City. It provides direction to protect natural and environmentally sensitive areas and develop complete, compact communities to maintain and enhance Surrey’s environmental quality. This plan is currently being updated.
 - **Surrey Sustainability Charter, 2008.** The Charter provide a vision for social, environmental and economic sustainability for the City. Environmental goals pertain to protection of terrestrial/ aquatic habitat and life and developing in a manner that protects and incorporates environmental values.
 - **Surrey Ecosystem Management Study, 2011 (EMS).** The EMS mapped the City’s environmental features and vegetation types and developed options for a Green Infrastructure Network (GIN). It provides a foundation for this *Biodiversity Conservation Strategy*.
 - **City of Surrey Tree Protection Bylaw, 2006 No. 16100.** The Tree Bylaw reduces the number of trees removed, killed, cut or damaged, by improved protection and replanting requirements.
 - **Soil Conservation and Protection Bylaw, 2007 No. 16389.** Regulates removal and deposit of soil to ensure appropriate development, environmental protection, and protection of agriculture.
- Pesticide Use Control Bylaw, 2011 No. 17160.** Regulates application of pesticide on public and private lands in the City of Surrey.

Appendix E – Description of Habitat Types

Forest Communities

The majority of natural habitat in Surrey is forest. These have been classified based on their species composition and successional development stage.

OLD GROWTH FOREST

Old growth forests develop through a process of natural succession to a stage where tree species composition and structure are relatively stable. Forests reach this stage at different times depending on geography and climate; 240 years is considered an appropriate benchmark for old growth forests on British Columbia's west coast. These forests are structurally diverse and dominated by shade tolerant climax tree species. Habitat characteristics include a variety of tree sizes and ages, canopy gaps, snags (wildlife trees), and large, coarse woody debris.

MATURE FOREST

This habitat type includes trees between 80 and 240 years old. Most mature forest in Surrey regenerated naturally following clearing of original old growth stands at the turn of the century. As a result, trees are younger (80 to 120 years). These stands share many of the characteristics of old growth forests. However, there is a general absence of very large trees and structural diversity is not quite as high.

YOUNG MIXED FOREST

This forest type developed following more recent human disturbance; trees are typically between 5 and 80 years old. Young mixed forests are relatively even-aged, moderately dense, and have a low structural diversity. The deciduous or coniferous component does not represent more than 70% of forest cover.

YOUNG DECIDUOUS FOREST

This forest type developed following more recent human disturbance; trees are typically between 5 and 80 years old.

Young deciduous forests are relatively even-aged, moderately dense, and have minimal structural diversity. Deciduous trees compose more than 70% of the stand type.

YOUNG EVERGREEN FOREST

This forest type developed following more recent human disturbance; trees are typically between 5 and 80 years old. Young evergreen forests are relatively even-aged, moderately dense, and have low structural diversity. Coniferous species dominate the stand type, representing more than 70% of canopy cover.

Aquatic Communities (Freshwater)

Freshwater aquatic communities include areas with flowing water (rivers), areas of open water (lakes, ponds), and areas where standing water occurs at or near the soil surface for all or part of the year (wetlands). Vegetation in these areas is characterized by hydrophilic plant species (i.e. plants tolerant of waterlogged conditions).

STREAM

A stream is a defined channel of flowing water. They can be part of natural or constructed drainage systems, and are often fed by smaller tributaries. Smaller streams are often referred to as creeks.

POND/LAKE

A lake is defined as a large body of open water surrounded by land. Ponds are sometimes differentiated from lakes on the basis of size and depth, although there is no consistent definition. Generally, ponds may be considered smaller and/or shallower.

WETLANDS

Wetlands include areas of fluctuating and/or standing water at or near the soil surface. Saturated conditions influence soil

development and support specialized plant species that are adapted to these conditions. Wetlands are sub-classified as marshes, swamps, fens and bogs.

Marshes are shallow, flooded wetlands with usually a mineral substrate, and often have a fluctuating water table. They are the most nutrient rich wetland. Vegetation includes forbs, with few trees.

Bogs are peatlands that are generally unaffected by groundwater or surface runoff; precipitation is the major water input. This lack of water flow results in lower nutrient availability. Sphagnum moss is a dominant plant, and is largely responsible for creating the acidic and nutrient poor conditions associated with bog ecosystems. Vegetation typically includes Sphagnum moss, ericaceous shrubs, and conifers

Fens are peatlands that develop under the influence of groundwater flow and a fluctuating water table. They can be neutral or slightly alkaline and are more nutrient rich than bogs. Fens are often dominated by sedges, grasses, reeds and brown mosses.

Swamps are tree or shrub dominated wetlands that have a flowing or fluctuating water table near the surface. They can occur on both mineral soil and peatland.

Aquatic Communities (Marine)

Marine habitats in the Surrey area are generally included as part of the Fraser River Estuary. These include Boundary Bay, Mud Bay, and Semiahmoo Bay. These are shallow tidal mudflats open to the ocean but periodically diluted by fresh water from the Fraser, Serpentine, Nicomekl, or Campbell Rivers, resulting in variable salinity. Although most of this area is outside the City's jurisdiction there are habitat components (e.g. shoreline, salt marshes) that are significant.

INTERTIDAL FLATS; SHALLOW WATER; SALT MARSH

These habitat types occupy the transition zone between the low and high tide level. Intertidal flats and shallow water areas are dominated by non-vascular plants and eelgrass. Estuarine marshes are located between the mid to high tide level and are dominated by halophytic (salt-loving) plants.

Shrub and Herb Communities

UNMANAGED HERB AND GRASS

These habitat types represent an early stage of ecological succession. They generally develop following recent forest clearing or are maintained in this vegetative state either because of environmental conditions (e.g. growing substrate, cold air, high water table) or by human activities. Many of these habitats are classified as oldfields (unmaintained fields previously used for agriculture). Vegetation in these habitats is dominated by grass and herbs; forest cover is generally less than 10%.

UNMANAGED SHRUB

Characteristic vegetation for this habitat type includes woody shrubs and short trees (<5m tall). Due to increased sun exposure, these open areas are often dominated by invasive shrubs such as Himalayan Blackberry. Landscape gardens and hedgerows are also included in this habitat type.

Agricultural Communities

Areas with a history of farming have unique habitats that are

influenced by ongoing soil management, crop production and livestock use. These include pastures, seasonally flooded fields, row crops (vegetable and berry production) and corrals.

AGRICULTURAL HERB AND GRASS

This habitat type includes fields actively used for agriculture, with the exception of row crops. Pastures and fallow fields are common, but also some gardens.

AGRICULTURE ROW CROPS

This habitat includes areas that are actively farmed. Characteristic crops include low shrubs such as berries.

Developed Areas

Developed areas are highly influenced by human activity for residential, commercial, institutional, and industrial uses.

URBAN TREES

These areas include rows and small patches of trees in the urban matrix. Urban trees occur mostly on large private lots. Groups of trees grow together as a small stand, but the understory is often maintained (turf) or been disturbed from a natural state

TURF GRASS

These areas are maintained and irrigated as turf grass for golf courses, private yards, parks and sports fields.

URBAN SUBURBAN LOW DENSITY

Areas generally zoned for suburban lots and low density housing, including acreages or those zones amenable to preservation of open space (e.g. cluster residential zones). These areas are typically associated with a high percentage of forest cover and natural areas.

URBAN SUBURBAN MEDIUM DENSITY

Areas generally zoned for single family dwellings and duplexes.



These areas are typically associated with a moderate percentage of forest cover and natural areas, with a corresponding increase in developed, impermeable footprint (roads, sidewalks, buildings).

URBAN SUBURBAN HIGH DENSITY

Areas generally zoned for commercial and industrial use and high density residential housing, including condominiums, row housing and townhouses. These areas are typically associated with a low percentage of forest cover and natural areas, with a high proportion of impermeable surfaces.

Appendix F

Species Lists and Guilds

CONSERVATION STATUS LEGEND (THIRD COLUMN)	
Y	Yellow listed
B	Blue listed
R	Red listed
E	Extirpated
N	Non-native (introduced)
D	Data deficient (current presence uncertain, existed historically)

LEGEND (NINTH TO SIXTEENTH COLUMN)	
X	Resident
X (B)	Breeding
X (W)	Wintering

COMMON NAME	SCIENTIFIC NAME	STATUS	YOUNG DECIDUOUS FOREST	YOUNG MIXED FOREST	YOUNG EVERGREEN	MATURE FOREST	OLD GROWTH FOREST	UNMANAGED HERB AND GRASS*	UNMANAGED SHRUB*	MARINE INTERTIDAL/ ESTUARINE MARSH	WETLAND MARSH	WETLAND BOG	FRESHWATER LAKE/ POND/ DITCH	FRESHWATER RIVER**	RIPARIAN - FRESHWATER	COMMENTS
BIRDS																
Tundra Swan	<i>Cygnus columbianus</i>	Y						x		x	x	x	x	x		
Trumpeter Swan	<i>Cygnus buccinator</i>	B						x		x	x	x	x	x		
Mute Swan	<i>Cygnus olor</i>	N								x	x	x	x	x		
Greater White-fronted Goose	<i>Anser albifrons</i>	Y						x		x	x	x	x	x		
Snow Goose	<i>Chen caerulescens</i>	Y								x	x	x	x	x		
Brant	<i>Branta bernicla</i>	Y								x						
Canada Goose	<i>Branta canadensis</i>	Y						x		x	x	x	x	x		
Wood Duck	<i>Aix sponsa</i>	Y	x (n)	x (n)		x (n)					x	x	x	x	x (n)	
Green-winged Teal	<i>Anas crecca</i>	Y						x		X (W)	X	x	x	x	x (n)	
Mallard	<i>Anas platyrhynchos</i>	Y						x		X (W)	x	x	x	x	x (n)	
Northern Pintail	<i>Anas acuta</i>	Y						x		X (W)	x	x	x	x		
Blue-winged Teal	<i>Anas discors</i>	Y								x	x	x	x			
Cinnamon Teal	<i>Anas cyanoptera</i>	Y								x	X (B)	x	x			
Northern Shoveler	<i>Anas clypeata</i>	Y						x		x	x	x	x			
Gadwall	<i>Anas strepera</i>	Y								x	x	x	x	x		
Eurasian Wigeon	<i>Anas penelope</i>	Y						x		x	x	x	x	x		
American Wigeon	<i>Anas americana</i>	Y						x		X (W)	x	x	x	x		
Canvasback	<i>Aythya valisineria</i>	Y								x	x		x	x		
Redhead	<i>Aythya americana</i>	Y								x	x		x	x		
Ring-necked Duck	<i>Aythya collaris</i>	Y								x	x	x	X	x		
Greater Scaup	<i>Aythya marila</i>	Y								X (W)	x	x	x	x		
Lesser Scaup	<i>Aythya affinis</i>	Y								x	x	x	x	x		
Harlequin Duck	<i>Histrionicus histrionicus</i>	Y								X (W)				x		
Long-tailed Duck	<i>Clangula hyemalis</i>	B								x				x		
Black Scoter	<i>Melanitta nigra</i>	Y								x						
Surf Scoter	<i>Melanitta perspicillata</i>	B								X (W)			x	x		
White-winged Scoter	<i>Melanitta fusca</i>	Y								X (W)						
Common Goldeneye	<i>Bucephala clangula</i>	Y								x	X (W)	X (W)	X (W)	X (W)		

Table 30. Species List and Guilds

*Does not include managed agricultural forage fields and annual crops. **Includes terrestrial habitat only.

COMMON NAME	SCIENTIFIC NAME	STATUS	YOUNG DECIDUOUS FOREST	YOUNG MIXED FOREST	YOUNG EVERGREEN	MATURE FOREST	OLD GROWTH FOREST	UNMANAGED HERB AND GRASS*	UNMANAGED SHRUB*	MARINE INTERTIDAL/ ESTUARINE MARSH	WETLAND MARSH	WETLAND BOG	FRESHWATER LAKE/ POND/ DITCH	FRESHWATER RIVER**	RIPARIAN - FRESHWATER	COMMENTS
Barrow's Goldeneye	<i>Bucephala islandica</i>	Y								X	x	x	x	x		
Bufflehead	<i>Bucephala albeola</i>	Y								X (W)	X (W)	X (W)	X (W)	X (W)		
Hooded Merganser	<i>Lophodytes cucullatus</i>	Y	x	x						x	X	X	X	X	x (n)	
Common Merganser	<i>Mergus merganser</i>	Y	x	x						x	x	x	x	x	x (n)	
Red-breasted Merganser	<i>Mergus serrator</i>	Y								X (W)	x	x		x		
Ruddy Duck	<i>Oxyura jamaicensis</i>	Y								x	x	x	x	x		
Ring-necked Pheasant	<i>Phasianus colchicus</i>	N, E						x							x	
Ruffed Grouse	<i>Bonasa umbellus</i>	Y	X	X	x	X	X								x	
Common Loon	<i>Gavia immer</i>	Y								X (W)				x		
Pacific Loon	<i>Gavia pacifica</i>	Y								x						
Pied-billed Grebe	<i>Podilymus podiceps</i>	Y								x	X	X	X	x		
Horned Grebe	<i>Podiceps auritus</i>	Y								X (W)	x			x		
Eared Grebe	<i>Podiceps nigricollis</i>	Y								x						
Western Grebe	<i>Aechmophorus occidentalis</i>	R								x				x		
Clark's Grebe	<i>Aechmophorus clarkii</i>	Y								x				x		
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	B								X			x	x		
Brandt's Cormorant	<i>Phalacrocorax penicillatus</i>	R								x						
Pelagic Cormorant	<i>Phalacrocorax pelagicus</i>	Y								x						
American Bittern	<i>Botaurus lentiginosus</i>	B								x	X (B)	x				
Great Blue Heron ssp. fannini	<i>Ardea herodias fannini</i>	B						x		X	X	x	x	x	x	
Green Heron	<i>Butorides striatus</i>	B									x	x	x	x	X (B)	
Osprey	<i>Pandion haliaetus</i>	Y								x			x	X (B)		
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Y	x	x	x	x	x	x		x	x	x	x	x	X	
Northern Harrier	<i>Circus cyaneus</i>	Y						X	x	x	x	x				
Cooper's Hawk	<i>Accipiter cooperii</i>	Y	X	X	x	x	x	x	x						X	
Northern Goshawk ssp. laingi	<i>Accipiter gentilis laingi</i>	Y	x	x	x	x	x	x	x						x	
Sharp-shinned Hawk	<i>Accipiter striatus</i>	Y	x	x	x	x	x	x	x						x	
Red-tailed Hawk	<i>Buteo jamaicensis</i>	Y	X(B)	X(B)	x	x	x	X							X (B)	
Rough-legged Hawk	<i>Buteo lagopus</i>	B						X (W)			x	x				
American Kestrel	<i>Falco sparverius</i>	Y	x	x				x	x		x	x			x	
Merlin	<i>Falco columbarius</i>	Y	x	x	x	x	x	x	x	x	x	x			x	
Peregrine Falcon ssp. pealei	<i>Falco peregrinus pealei</i>	B						x		x						
Peregrine Falcon ssp. anatum	<i>Falco peregrinus anatum</i>	R						x	x	x	x	x	x	x		
Gyr Falcon	<i>Falco rusticolus</i>	B						x		x	x	x	x	x		
Sora Rail	<i>Porzana carolina</i>	Y									X (B)	x				
Virginia Rail	<i>Rallus limicola</i>	Y									X (B)	x				
American Coot	<i>Fulica americana</i>	Y								x	X (W)	x	X (W)	x		

COMMON NAME	SCIENTIFIC NAME	STATUS	YOUNG DECIDUOUS FOREST	YOUNG MIXED FOREST	YOUNG EVERGREEN	MATURE FOREST	OLD GROWTH FOREST	UNMANAGED HERB AND GRASS*	UNMANAGED SHRUB*	MARINE INTERTIDAL/ ESTUARINE MARSH	WETLAND MARSH	WETLAND BOG	FRESHWATER LAKE/ POND/ DITCH	FRESHWATER RIVER**	RIPARIAN - FRESHWATER	COMMENTS
Sandhill Crane	<i>Grus canadensis</i>	Y								x	x	X (B)				
American Golden-plover	<i>Pluvialis dominica</i>	B								x						
Black-bellied Plover	<i>Pulvialis squatarola</i>	Y								x						
Dunlin	<i>Calidris alpina</i>	Y								X (W)	x	x				
Western Sandpiper	<i>Calidris mauri</i>	Y								X (W)	x	x				
Least Sandpiper	<i>Calidris minutilla</i>	Y								x	x	x		x		
Short-billed Dowitcher	<i>Limnodromus griseus</i>	B								x	x	x				
Long-billed Dowitcher	<i>Limnodromus scolopaceus</i>	Y								X (W)	x	x				
Greater Yellowlegs	<i>Tringa melanoleuca</i>	Y								X (W)	x	x				
Lesser Yellowlegs	<i>Tringa flavipes</i>	Y								x	x	x				
Herring Gull	<i>Larus argentatus</i>	Y								x			x	x		
Ring-billed Gull	<i>Larus delawarensis</i>	Y								x			x	x		
California Gull	<i>Larus californicus</i>	B								x			x	x		
Mew Gull	<i>Larus canis</i>	Y								x	x	x	x	x		
Glaucous-winged Gull	<i>Larus glaucescens</i>	Y								x	x	x	x	x		
Caspian Tern	<i>Sterna caspia</i>	B								x						
Common Murre	<i>Uria aalge</i>	R								?						
Marbled Murrelet	<i>Brachyramphus marmoratus</i>	B								x						
Band-tailed Pigeon	<i>Columba fasciata</i>	B	x	x	x	x	x		x						x	
Eurasian Collared-dove	<i>Streptopelia decaocto</i>	N														Human altered habitats
Mourning Dove	<i>Zenaidura macroura</i>	Y						x							x	Field & field edge trees/shrubs
Barn Owl	<i>Tyto alba</i>	B						x							x	
Western Screech Owl ssp. kennicottii	<i>Otus kennicottii kennicottii</i>	B	x	x	x	x	x	x							X	
Great Horned Owl	<i>Bubo virginianus</i>	Y	x	x	x	X	X	x		x	x	x			x	
Spotted Owl	<i>Strix occidentalis</i>	R, E														
Barred Owl	<i>Strix varia</i>	Y	x	x	x	x	x					x			x	
Short-eared Owl	<i>Asio flammeus</i>	B						X		x	x	x				
Long-eared Owl	<i>Asio otus</i>	Y	x	x				x	x		x	x			x	
Northern Saw-whet Owl	<i>Aegolius acadicus</i>	Y	x	x	x	x	x	x			x	x			x	
Black Swift	<i>Cypseloides niger</i>	Y	x	x	x	x	x	x	x	x	x	x	x	x	x	
Vaux's Swift	<i>Chaetura vauxi</i>	Y	x	x	x	X	X	x	x	x	x	x	x	x	x	
Anna's Humminbird	<i>Calypte anna</i>	Y	x	x					x						x	
Rufous Hummingbird	<i>Selasphorus rufus</i>	Y	x	x	x	x	x	x	x		x	x			x	
Belted Kingfisher	<i>Megaceryle alcyon</i>	Y								x	X	x	X	X	x	Riparian for perching while hunting. Bank nests usually in riparian areas.
Lewis' Woodpecker	<i>Melanerpes lewis</i>	B, E														Coastal race extirpated
Downy Woodpecker	<i>Picoides pubescens</i>	Y	X	X				x	x		x				x	

COMMON NAME	SCIENTIFIC NAME	STATUS	YOUNG DECIDUOUS FOREST	YOUNG MIXED FOREST	YOUNG EVERGREEN	MATURE FOREST	OLD GROWTH FOREST	UNMANAGED HERB AND GRASS*	UNMANAGED SHRUB*	MARINE INTERTIDAL/ ESTUARINE MARSH	WETLAND MARSH	WETLAND BOG	FRESHWATER LAKE/ POND/ DITCH	FRESHWATER RIVER**	RIPARIAN - FRESHWATER	COMMENTS
Hairy Woodpecker	<i>Picooides villosus</i>	Y	x	x		X	X								X	
Northern Flicker	<i>Colaptes auratus</i>	Y	X	X	x	x	x	x							x	
Pileated Woodpecker	<i>Dryocopus pileatus</i>	Y	x	x	x	X	X								x	
Red-breasted Sapsucker	<i>Sphyrapicus ruber</i>	Y	x	x	X	x	x								x	
Olive-sided Flycatcher	<i>Contopus cooperi</i>	B	x	x				x	x			x				
Western Wood-pewee	<i>Contopus sordidulus</i>	Y	x	x					x						x	
Willow Flycatcher	<i>Empidonax traillii</i>	Y						x	x		x	x			X (B)	
Hammond's Flycatcher	<i>Empidonax hammondi</i>	Y	x	x	x	x	x									
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	Y	x	X (B)	x	X (B)	X (B)								x	
Northern Shrike	<i>Lanius excubitor</i>	Y						X (W)	x							
Cassin's Vireo	<i>Vireo cassinii</i>	Y	x	x											x	
Hutton's Vireo	<i>Vireo huttoni</i>	Y	x	x	x	x	x								x	
Warbling Vireo	<i>Vireo gilvus</i>	Y	X (B)	X (B)		X (B)									X (B)	
Red-eyed Vireo	<i>Vireo olivaceus</i>	Y	x	x		X (B)									x	
Steller's Jay	<i>Cyanocitta stelleri</i>	Y	x	x	x	x	x		x						x	
Northwestern Crow	<i>Corvus caurinus</i>	Y	x	x				x	x	x					x	
Common Raven	<i>Corvus corax</i>	Y	x	x	x	x	x	x	x	x					x	
Horned Lark ssp. strigata	<i>Eremophila alpestris strigata</i>	R, E														Unlikely but possible in Surrey
Purple Martin	<i>Progne subis</i>	B								x				x		Use artificial nest boxes in estuarine & large coastal river habitats
Tree Swallow	<i>Tachycineta bicolor</i>	Y	x	x				x	x	x	x	x	x	x	X (B)	
Violet-green Swallow	<i>T. thalassina</i>	Y	x	x				x	x	x	x	x	x	x	x	Nests in any open forest edge with suitable tree or cliff cavities
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	Y	x	x				x	x	x	x	x	x	x	x	Nests in any open habitat with suitable banks
Bank Swallow	<i>Riparia riparia</i>	Y	x	x				x	x	x	x	x	x	x	x	Nests in any open habitat with suitable banks
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	Y						x	x	x	x	x	x	x		Nests in any open habitat with suitable nesting cliffs, bridges, buildings.
Barn Swallow	<i>Hirundo rustica</i>	B	x	x				x	x	x	x	x	x	x		Nests in any open habitat with suitable nesting bridges, buildings, or sometimes shallow caves.
Black-capped Chickadee	<i>Poecile atricapilla</i>	Y	x	x				x	x		x	x			x	
Chestnut-backed Chickadee	<i>Poecile rufescens</i>	Y	x	x	x	X	X								x	
Bushtit	<i>Psaltriparus minimus</i>	Y	x	x				x	x		x	x			x	
Red-breasted Nuthatch	<i>Sitta canadensis</i>	Y	x	x	x	x	x								x	
Brown Creeper	<i>Certhia americana</i>	Y	x	x	x	X	X								x	
Bewick's Wren	<i>Thryomanes bewickii</i>	Y	x	x					x						X	
Pacific Wren	<i>Troglodytes pacificus</i>	Y	x	X	X	X	X		x						x	
Marsh Wren	<i>Cistothorus palustris</i>	Y						x			X (B)	x				
American Dipper	<i>Cinclus mexicanus</i>	Y											x	X (B)		
Golden-crowned Kinglet	<i>Regulus satrapa</i>	Y	x	x	X	x	x								x	

COMMON NAME	SCIENTIFIC NAME	STATUS	YOUNG DECIDUOUS FOREST	YOUNG MIXED FOREST	YOUNG EVERGREEN	MATURE FOREST	OLD GROWTH FOREST	UNMANAGED HERB AND GRASS*	UNMANAGED SHRUB*	MARINE INTERTIDAL/ ESTUARINE MARSH	WETLAND MARSH	WETLAND BOG	FRESHWATER LAKE/ POND/ DITCH	FRESHWATER RIVER**	RIPARIAN - FRESHWATER	COMMENTS
Ruby-crowned Kinglet	<i>Regulus calendula</i>	Y	x	x	x	x	x		x						x	
Swainson's Thrush	<i>Catharus ustulatus</i>	Y	X (B)	X (B)	X (B)	X (B)	x		x	x					x	
Hermit Thrush	<i>Catharus guttatus</i>	Y	x	x	x	x	x			x					x	
American Robin	<i>Turdus migratorius</i>	Y	x	x	x	x	x	x	x	x	x	x			x	
Varied Thrush	<i>Ixoreus naevius</i>	Y	x	x	x	x	x								x	
European Starling	<i>Sturnus vulgaris</i>	N	x	x				x	x	x	x	x			x	
American Pipit	<i>Anthus rubescens</i>	Y						x		x						
Bohemian Waxwing	<i>Bombycilla garrulus</i>	Y	x	x					x						x	
Cedar Waxwing	<i>Bombycilla cedrorum</i>	Y	x	x					x		x	x			x	
Orange-crowned Warbler	<i>Vermivora celata</i>	Y	x	x					x						x	
Yellow Warbler	<i>Dendroica petechia</i>	Y	x	x					x		x	x			X (B)	
Yellow-rumped Warbler	<i>Dendroica coronata</i>	Y	x	x	x	x	x		x						x	
Black-throated Gray Warbler	<i>D. nigrescens</i>	Y	x	x		x	x				x	x			X (B)	
Townsend's Warbler	<i>Dendroica townsendi</i>	Y		x	x	x	x								x	
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	Y	x	x					x		x	x			x	Shrubby deciduous habitat in open & forested, wet & dry situations
Common Yellowthroat	<i>Geothlypis trichas</i>	Y						x	x		X (B)	x				Freshwater wetland emergent vegetation
Wilson's Warbler	<i>Wilsonia pusilla</i>	Y	x	x					x						x	Shrubby deciduous habitats
Western Tanager	<i>Piranga ludoviciana</i>	Y	x	x	x	x	x		x						x	Open, generally drier forested habitats
Spotted Towhee	<i>Pipilo maculatus</i>	Y	X	X		X	x	x	X		x	x			x	
Savannah Sparrow	<i>Passerculus sandwichensis</i>	Y						X (B)	x							
Fox Sparrow	<i>Passerella iliaca</i>	Y	x	x				x	X (W)	x	x	x			x	
Song Sparrow	<i>Melospiza melodia</i>	Y	X	X		X	x	x	X	x	x	x			X	
Lincoln's Sparrow	<i>Melospiza lincolnii</i>	Y						X (W)	x							
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	Y	x	x				x	x							
Golden-crowned Sparrow	<i>Zonotrichia atricapilla</i>	Y						x	x							
Dark-eyed Junco	<i>Junco hyemalis</i>	Y	X (W)	X (W)	x	X (B)	X (B)	x	X (W)	x	x	x			x	
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	Y	x	x					x		x	x			x	
Lazuli Bunting	<i>Passerina amoena</i>	Y						x								
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	Y						x	x	x	X (B)	x				
Western Meadowlark	<i>Sturnella neglecta</i>	Y						X (W)	x							
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	Y	x	x				x								
Brown-headed Cowbird	<i>Molothrus ater</i>	Y	x	x	x	x	x	x	x	x	x	x			x	
Bullock's Oriole	<i>Icterus bullockii</i>	Y	x	x											X (B)	
Pine Grosbeak	<i>Pinicola enucleator</i>	Y	x	x	x	x	x									
Purple Finch	<i>Carpodacus purpureus</i>	Y	x	x					x						X	
House Finch	<i>Carpodacus mexicanus</i>	Y	x	x					x						x	
Red Crossbill	<i>Loxia curvirostra</i>	Y	x	x	x	x	x								x	

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Pine Siskin	<i>Carduelis pinus</i>	Y	x	x	x	x	x		x						x	
American Goldfinch	<i>Carduelis tristis</i>	Y	x	x				x	x		x	x			x	
Evening Grosbeak	<i>Coccothraustes vespertinus</i>	Y	x	x	x	x	x								x	
House Sparrow	<i>Passer domesticus</i>	N						x	x							Associated primarily with buildings
MAMMALS																
Virginia Opossum	<i>Didelphis virginiana</i>	N	x	x		x		x	x	x	x	x	x	x	x	near water and farms
Pacific Water Shrew	<i>Sorex bendirii</i>	R	x	x		x	x			x	x	x	x	x	x	seldom far from standing or slow moving water
Trowbridge's Shrew	<i>Sorex trowbridgii</i>	B	x	x	x	x	x								x	north facing slope and ravines
Olympic Shrew	<i>Sorex rohweri</i>	R	x	x	x	x	x					x			x	data deficient
Cinereus (Common) Shrew	<i>Sorex cinereus</i>	Y	x	x	x	x	x	x	x	x	x	x			x	Prefers moist - wet habitats
Dusky Shrew	<i>Sorex monticolus</i>	Y	x	x	x	x	x								x	Primarily a forest species
Vagrant Shrew	<i>Sorex vagrans</i>	Y	x	x	x	x	x	x			x	x			x	wide range of habitats
Shrew-mole	<i>Neurotrichus gibbsii</i>	Y	x	x	x	x	x								x	large woody debris
Western Long-eared Myotis	<i>Myotis evotis</i>	Y	x	x	x	x	x						x	x	x	
Keen's Long-eared Myotis	<i>Myotis keenii</i>	R	x	x	x	x	x							x	x	not likely present
Little Brown Myotis	<i>Myotis lucifugus</i>	Y	x	x	x	x	x	x	x		x	x	x	x	x	
California Myotis	<i>Myotis californicus</i>	Y	x	x	x	x	x	x	x		x	x	x	x	x	
Long-legged Myotis	<i>Myotis volans</i>	Y	x	x	x	x	x							x	x	none breeding
Yuma Myotis	<i>Myotis yumanensis</i>	Y	x	x	x	x	x	x		x	x	x	x	x	x	hunts over water
Hoary Bat	<i>Lasiurus cinereus</i>	Y	x	x	x	x	x								x	tree bat
Townsend's Big-eared Bat	<i>Plecotus townsendii</i>	B	x	x	x	x	x							x	x	sensitive to human disturbance
Big Brown Bat	<i>Eptesicus fuscus</i>	Y	x	x	x	x	x								x	tree bat, data deficient
Eastern Cottontail	<i>Sylvilagus floridanus</i>	N	X	X		X		X	X						x	open areas
Snowshoe Hare ssp. washingtonian	<i>Lepus americanus washingtonian</i>	R, d	x	x	x	x	x					x			x	winters in very dense cover, data deficient
North American Deer Mouse	<i>Peromyscus maniculatus</i>	Y	x	x	x	x	x	x	x	x	x	x		x	x	
Southern Red-backed Vole ssp. occidentalis	<i>Myodes gapperi occidentalis</i>	R, d		x	x											Pine forest with Salal understory, data deficient
Long-tailed Vole	<i>Microtus longicaudus</i>	Y	x	x	x	x	x		x							forest edge
Creeping Vole	<i>Microtus oregoni</i>	Y	x	x		x	x	x	x						x	
Townsend's Vole	<i>Microtus townsendii</i>	Y						X	x		x				x	wet meadows
Muskrat	<i>Ondatra zibethica</i>	Y								X	X	x	X	x		
Beaver	<i>Castor canadensis</i>	Y	x	x	x	x	x			x	x	x	x	x	x	
Northern Flying Squirrel	<i>Glaucomys sabrinus</i>	Y	X	X	X	X	X								x	
Gray Squirrel	<i>Sciurus carolinensis</i>	N	x	x	x				x						x	
Douglas Squirrel	<i>Tamiasciurus douglasii</i>	Y	X	X	X	X	X		x						x	
Townsend's Chipmunk	<i>Neotamias townsendii</i>	Y	x	x	x	x	x									
Pacific Jumping Mouse	<i>Zapus trinotatus</i>	Y						x			x		x		X	moist meadows, riparian thickets, swims well
House Mouse	<i>Mus musculus</i>	N						x	x							

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Norway Rat	<i>Rattus norvegicus</i>	N							x	x						
Roof Rat, Black Rat	<i>Rattus rattus</i>	N	x	x		x	x									
Coyote	<i>Canis latrans</i>	Y	x	x	x	x	x	x	x	x	x	x			x	
Gray Wolf	<i>Canis lupus</i>	E	x	x	x	x	x								x	extirpated
Red Fox	<i>Vulpes vulpes</i>	Y, d	x	x		x		x	x	x				x	x	likely extirpated, data deficient
Cougar	<i>Felis concolor</i>	E	x	x	x	x	x								x	extirpated
Bobcat ssp. fasiatus	<i>Lynx rufus fasciatus</i>	Y, d	x	x	x	x	x	x	x						x	extirpated
River Otter	<i>Lontra canadensis</i>	Y								x	x	x	x	X	x	
Marten	<i>Martes americana</i>	E					x								x	extirpated
Fisher	<i>Martes pennanti</i>	B, E					x								x	extirpated
Striped Skunk	<i>Mephitis mephitis</i>	Y						x	x		x	x			x	
Ermine ssp. fallenda	<i>Mustela erminea fallenda</i>	Y	X	X	X	X	X	x	x						x	
Long-tailed weasel ssp. altifrontalis	<i>Mustela frenata altifrontalis</i>	R, E	x	x	x	x	x	x	x	x	x		x	x	x	
Mink	<i>Mustela vison</i>	Y								X	X	X	X	X	X	
Spotted Skunk	<i>Spilogale putorius</i>	E	x	x		x	x								x	
Raccoon	<i>Procyon lotor</i>	Y	x	x	x	x	x	x	x	x	x	x			x	
Black Bear	<i>Ursus americanus</i>	Y	x	x	x	x	x	x	x		x	x		x	x	
Grizzly Bear	<i>Ursus arctos</i>	B, E	x				x							x	x	
Elk ssp. roosevelti	<i>Cervus elaphus roosevelti</i>	E	x	x		x									x	
Mule deer ssp. columbianus	<i>Odocoileus h. columbianus</i>	Y	X	X	X	x	x	x	x	x	x	x			x	
AMPHIBIANS																
Western Toad	<i>Anaxyrus boreas</i>	B	x	x	x	x	x	x	x		x	x	x	x	x	
Pacific Treefrog	<i>Pseudacris regilla</i>	Y	x	x	x	x	x	x	x		X (B)	x	X (B)	x	x	
Northern Red-legged Frog	<i>Rana aurora</i>	B	x	x	x	x	x	x	x		X (B)	X (B)	X (B)	x	x	
Oregon Spotted Frog	<i>Rana pretiosa</i>	R									x		x	x	x	Breeding population in Campbell River till the 1980s
Green Frog	<i>Rana clamitans</i>	N									x	x	x	x	x	
American Bullfrog	<i>Rana catesbeiana</i>	N									x	x	x	x	x	
Northwestern Salamander	<i>Ambystoma gracila</i>	Y	x	x	x	x	x		x		X (B)	X (B)	X (B)	x	x	
Long Toed Salamander	<i>Ambystoma macrodactylum</i>	Y	x	x	x	x	x	x	x		X (B)	X (B)	X (B)	x	x	
Ensatina	<i>Ensatina eschscholtzii</i>	Y	x	x		x	x		x						x	
Western Red-backed Salamander	<i>Plethodon vehiculum</i>	Y	x	x		x	x								x	
Rough-skinned Newt	<i>Taricha granulosa</i>	Y	x	x		x	x	x	x		x	x	x	x	x	
REPTILES																
Painted Turtle - Pacific Coast Population	<i>Chrysemys picta</i>	R									x		x	x	x	Reintroduction program in progress.
Red-eared Slider	<i>Trachemys scripta</i>	N									x		x	x	x	
Northern Alligator Lizard	<i>Igaria coerulea</i>	Y	x	x		x	x		x						x	
Northwestern Garter Snake	<i>Thamnophis ordinoides</i>	Y	x	x		x	x	X	X	x	x	X	x	x	x	seldom enters water

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FRESHWATER FISH (EXCLUDING FRASER RIVER)																
Pink Salmon	<i>Oncorhynchus gorbuscha</i>	Y												x		
Chum Salmon	<i>Oncorhynchus keta</i>	Y												x		
Coho Salmon	<i>Oncorhynchus kisutch</i>	Y												X		
Sockeye Salmon	<i>Oncorhynchus nerka</i>	Y												x		
Chinook Salmon	<i>Oncorhynchus tshawytscha</i>	Y												x		
Coastal Cutthroat Trout	<i>Oncorhynchus clarkii clarkii</i>													X		
Rainbow/Steelhead Trout	<i>Oncorhynchus mykiss</i>	Y											X	x		
Dolly Varden	<i>Salvelinus malma malma</i>	Y											x	x		
Threespine Stickleback	<i>Gasterosteus aculeatus</i>	Y											x	x		
Pacific Lamprey	<i>Lampetra tridentata</i>	Y												x		
River Lamprey	<i>Petromyzontidae</i>	Y												x		
Longnose/Nooksack Dace	<i>Rhinichthys cataractae</i>	Y												x		
Goldfish	<i>Carassius auratus</i>	N											x			
Carp (common)	<i>Cyprinus carpio</i>	N											x			
Peamouth	<i>Mylocheilus caurinus</i>	Y											x	x		
Redside Shiner	<i>Richardsonius sp.</i>	Y											x	x		
Longnose Sucker	<i>Catostomus catostomus</i>	Y											x	x		
Largescale Sucker	<i>Castostomus snyderi</i>	Y											X	X		
Brown Bullhead Catfish	<i>Ameiurus nebulosus</i>	N											x			
Pumpkinseed Sunfish	<i>Lepomis gibbosus</i>	N											x			
Black Crappie	<i>Pomoxis nigromaculatus</i>	N											x			
Prickly Sculpin	<i>Cottus asper</i>	Y											X	X		
Slimy Sculpin	<i>Cottus cognatus</i>	Y											x	x		
VEGETATION																
Western Red Cedar	<i>Thuja plicata</i>			X	x	X	x									
Western Hemlock	<i>Tsuga heterophylla</i>			x	x	x	x									
Sitka Spruce	<i>Picea sitchensis</i>				x		x									
Douglas Fir	<i>Pseudotsuga menziesii ssp. menziesii</i>			x	x	X	X									
Shore Pine	<i>Pinus contorta var. contorta</i>						x					X				
Bigleaf Maple	<i>Acer macrophyllum</i>		x	x		x										
Black Cottonwood	<i>Populus balsamifera ssp. trichocarpa</i>		x	x		x										
Grand Fir	<i>Abies grandis</i>					x										
Red Alder	<i>Alnus rubra</i>		X	X												
Paper Birch	<i>Betula papyrifera</i>		x	x												
Bitter Cherry	<i>Prunus emarginata</i>		x													

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Cascara	<i>Rhamnus purshiana</i>		x	x												
European Mountain-ash (introduced)	<i>Sorbus aucuparia</i>		x	x												
Ocean Spray	<i>Holodiscus discolor</i>								x							
Salal	<i>Gaultheria shallon</i>		x	x	x	x	x									
Dull Oregon Grape	<i>Mahonia nervosa</i>				x	x	x									
Red Huckleberry	<i>Vaccinium parvifolium</i>				x	X	X									
Salmonberry	<i>Rubus spectabilis</i>		X	X					X							
Thimbleberry	<i>Rubus parviflorus</i>		x	x					x							
Indian Plum	<i>Oemleria cerasiformis</i>		x	x		x			x							
Cluster Rose	<i>Rosa pisocarpa</i>								x							
Baldhip Rose	<i>Rosa gymnocarpa</i>					x										
Nootka Rose	<i>Rosa nutkana</i>								x							
Vine Maple	<i>Acer circinatum</i>		x	x	x	x	x									
Snowberry	<i>Symphoricarpos albus</i>		x	x	x	x	x		x							
Beaked Hazelnut	<i>Corylus cornuta var. californica</i>		x	x		x										
Bracken Fern	<i>Pteridium aquilinum</i>					x										
Trailing Blackberry	<i>Rubus ursinus</i>		x	x		x			x							
Lady Fern	<i>Athyrium filix-femina</i>					x	x									
Deer Fern	<i>Blechnum spicant</i>				x	x										
Spiny Wood Fern	<i>Dryopteris expansa</i>				x	x										
Sword Fern	<i>Polystichum munitum</i>			x	x	x	x									
Siberian's Miner's Lettuce	<i>Claytonia sibirica</i>					x	x									
Bleeding Heart	<i>Dicentra formosa</i>		x													
Tall Fringecup	<i>Tellima grandiflora</i>		x	x												
Large Leaved Avens	<i>Geum macrophyllum</i>		x													
False Lily-of-the-valley	<i>Maianthemum dilatatum</i>		x													
Bunchberry	<i>Cornus canadensis</i>					x	x									
Hardhack	<i>Spiraea douglasii ssp. douglasii</i>		x	x				x	X							
Red Elderberry	<i>Sambucus racemosa</i>		x	x												
Scouler's Willow	<i>Salix scouleriana</i>		x													
Sitka Willow	<i>Salix sitchensis</i>		x													
Fireweed	<i>Epilobium angustifolium</i>								x							
Vanilla Leaf	<i>Achlys triphylla</i>					x										
Three Leaved Foamflower	<i>Tiarella trifoliata</i>			x	x	x										
Starflower	<i>Trientalis borealis</i>		x													
Stinging Nettle	<i>Urtica dioica</i>		x													
Stream Violet	<i>Viola glabella</i>		x			x										

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Western White Trillium	<i>Trillium ovatum</i>		x			x										
Swamp/Bog Laurel	<i>Kalmia microphylla ssp. Occidentalis</i>											x				
Orchard Grass (introduced)	<i>Dactylis glomerata</i>							X								
Tall Fescue (introduced)	<i>Lolium arundinaceum</i>							x								
Timothy Grass (introduced)	<i>Phleum pratense</i>							x								
Chamisso's Cottongrass	<i>Eriophorum chamissonis</i>											x				
Common Duckweed	<i>Lemna minor</i>										x		x			
Buckbean	<i>Menyanthes trifoliata</i>												x			
Small-flowered Bulrush	<i>Scirpus microcarpus</i>										x					
Beaked Sedge	<i>Rhynchospora alba</i>											x				
Serviceberry/Saskatoon	<i>Amelanchier alnifolia</i>		x													
Round-leaved Sundew	<i>Drosera rotundifolia</i>											x				
Labrador Tea	<i>Ledum groenlandicum</i>											X				
Bog Cranberry	<i>Oxycoccus oxycoccus</i>											x				
Peat Moss	<i>Sphagnum spp.</i>											X				
Sedges	<i>Cyperaceae</i>										X					
Bulrushes	<i>Typha latifolia</i>										X					
Rushes	<i>Juncus sp.</i>										x					
Stonewort	<i>Chara sp.</i>												x			
Sea Lettuce (a green seaweed)	<i>Ulva sp.</i>									x						
Common Eel-grass	<i>Zostera marina</i>									x						
Japanese Eel-grass (introduced)	<i>Zostera japonica</i>									x						
Seaside Arrow-grass	<i>Triglochin maritima</i>									x						
Saltmarsh Sand-spurry (introduced)	<i>Spergularia salina var. salina</i>									x						
American Glasswort	<i>Salicornia virginica (Sarcocornia pacifica)</i>									X						
Beaked Ditch-grass (washed in)	<i>Ruppia maritima</i>									x						
Sea Plantain	<i>Plantago maritima</i>									x						
Gerard's Rush	<i>Juncus gerardii</i>									x						
Rockweed (a brown seaweed washed in)	<i>Fucus sp.</i>									x						
Seashore Saltgrass	<i>Distichlis spicata var. spicata</i>									X						
Saltmarsh Dodder	<i>Cuscuta salina</i>									x						
Brass Buttons (introduced)	<i>Cotula coronopifolia</i>									x						
a green seaweed	<i>Enteromorpha sp.</i>									x						
Sea-milkwort	<i>Glaux maritima sp. obtusifolia</i>									x						
Yellow Water Lily	<i>Nuphar lutea</i>												X			
Broad Leaved Pondweed	<i>Potamogeton natans</i>												x			
Bladderwort	<i>Utricularia macrorrhiza</i>												x			

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Pond Water Starwort (introduced)	<i>Callitriche stagnalis</i>												x			
Himalayan Blackberry	<i>Rubus discolor</i>							x	X							
Evergreen Blackberry	<i>Rubus laciniatus</i>							X								
Reed Canary Grass	<i>Phalaris arundinacea</i>							X			x					
Red Clover	<i>Trifolium pratense</i>							x								
INVERTEBRATES (ODONATA)																
Spotted Spreadwing	<i>Lestes congener</i>		x					x	x		x	x	x		x	feeds at forest edge fields and wetlands
Common Spredwing	<i>Lestes disjunctus</i>		x					x	x		x	x	x		x	ponds with abundant aquatic vegetation,feeds at forest edge fields and wetlands
Lyre-tipped Spreadwing	<i>Lestes unguiculatus</i>		x					x	x		x	x	x		x	feeds at forest edge fields and wetlands
Western Red Damsel	<i>Amphiagrion abbreviatum</i>							x			x		x		x	prefers grass and sedge ponds, sloughs, slow water
Boreal Bluet	<i>Enallagma boreale</i>							x			x	x	x		x	
Tule Bluet	<i>Enallagma carunculatum</i>							x	x				x		x	
Northern Bluet	<i>Enallagma cyathigerum</i>							x	x		x		x		x	marshy areas
Pacific Forktail	<i>Ischnura cervula</i>							x	x		x		x		x	dense cattail and bulrush
Swift Forktail	<i>Ischnura erratica</i>							x	x		x	x	x		x	slow or till water
Western Forktail	<i>Ischnura perparva</i>							x	x		x		x		x	slow or till water
California Darner	<i>Aeshna californica</i>							x	x		x		x		x	
Variable Darner	<i>Aeshna interrupta</i>		x					x	x		x	x	x		x	
Paddle-tailed Darner	<i>Aeshna palmata</i>		x	x		x	x	x	x		x	x	x		x	feeds at forest edge fields and wetlands
Shadow Darner	<i>Aeshna umbrosa</i>		x	x		x	x	x	x		x		x		x	feeds at forest edge fields and wetlands
Bleu-eyed Darner	<i>Rhionaeschna multicolor</i>							x	x		x		x		x	marshy areas,
Common Green Darner	<i>Anax junius</i>		x	x				x	x		x		x		x	warm marsh and ponds, may feed at forest edge
Pacific Spiketail	<i>Cordulegaster dorsalis</i>		x	x				x	x				x		x	woodland streams flowing from lake and ponds
American Emerald	<i>Cordulia shurtleffi</i>		x	x					x		x	x	x		x	forested lakes and peatlands
Western Pondhawk	<i>Erythemis collocata</i>							x	x		x		x		x	ponds and marshy Lakes with floating plants
Dot-tailed Whitetail	<i>Leucorrhinia intacta</i>							x	x		x		x		x	ponds organically rich and marshy lake edge
Eight-spotted Skimmer	<i>Libellula forensis</i>							x	x		x		x		x	marshy lakes and ponds
Common Whitetail	<i>Plathemis lydia</i>							x	x		x		x		x	ponds, pools in streams, puddles and quiet corners of lakes
Four Spotted Skimmer	<i>Libellula quadrimaculata</i>		x	x		x	x	x	x		x	x	x		x	marshy edges of wetlands
Blue Dasher	<i>Pachydiplax longipennis</i>							x	x		x		x		x	ponds and lakes with abundant vegetation along the shore and in the water
Variiegated Meadowhawk	<i>Sympetrum corruptum</i>							x	x		x		x		x	rich ponds and marshes including temporary ones
Saffron-winged Meadowhawk	<i>Sympetrum costiferum</i>							x	x		x		x		x	open ponds and lakes
Cardinal Meadowhawk	<i>Sympetrum illotum</i>							x	x		x		x		x	open ponds and lakes
Cherry-faced Meadowhawk	<i>Sympetrum internum</i>							x	x		x	x	x		x	slow streams,grassland pond, cattail marshes, peatland pools
Red-veined Meadowhawk	<i>Sympetrum madidum</i>							x	x		x		x		x	still water habitats, marshes, sedge fens and grassland ponds
White-faced Meadowhawk	<i>Sympetrum obtusum</i>		x	x		x	x	x	x		x	x	x		x	

COMMON NAME	SCIENTIFIC NAME	STATUS	YOUNG DECIDUOUS FOREST	YOUNG MIXED FOREST	YOUNG EVERGREEN	MATURE FOREST	OLD GROWTH FOREST	UNMANAGED HERB AND GRASS	UNMANAGED SHRUB	MARINE INTERTIDAL/ ESTUARINE MARSH	WETLAND MARSH	WETLAND BOG	FRESHWATER LAKE/ POND/ DITCH	FRESHWATER RIVER	RIPARIAN - FRESHWATER	COMMENTS
Striped Meadowhawk	<i>Sympetrum pallipes</i>							x	x		x	x	x		x	
Autumn Meadowhawk	<i>Sympetrum vicinum</i>							x	x		x		x		x	ponds, slow streams and lakes with dense emergent vegetation
INVERTEBRATES (LEPIDOPTERA)																
Clodius Parnassian	<i>Parnassius clodius magnus</i>		x	x		x	x								x	Host Plant: bleeding heart
Anise Swallowtail	<i>Papilio zelicaon</i>							x	x							Host Plant: cow parsnip, fennel, Lovage, carrot family
Western Tiger Swallowtail	<i>Papilio rutulus</i>		x	x		x	x	x	x						x	Host Plant: willows, poplars, aspen, cottonwood, bitter cherry
Pale Swallowtail	<i>Papilio eurymedon</i>		x	x		x	x	x	x						x	Host Plant: bitter cherry, red alder, ocean spray, ceanothus
Margined White	<i>Pieris marginalis marginalis</i>							x	x		x				x	Host Plant: mustard family
Cabbage White	<i>Pieris rapae</i>							x	x		x				x	Host Plant: mustard family, - cabbage, broccli
Sara Orangetip	<i>Anthocharis sara flora</i>							x	x							Host Plant: arabis, mustard family
Clouded Sulpher	<i>Colias philodice eriphyle</i>							x								Host Plant: red clover, white clover, alfalfa
Orange Sulphur	<i>Colias eurytheme</i>							x								Host Plant: pea family, lupines, vetch, clover, sweet clover, alfalfa
Purplish Copper	<i>Lycaena helloides</i>							x								Host Plant: dock, sorrel and knotweed
Reakirt's Copper	<i>Lycaena mariposa mariposa</i>							x								Host Plant: native blueberries, and huckleberrys
Western Brown Elfin	<i>Incisalia iroides iroides</i>							x								Host Plant: salal, arbutus
Cedar Hairstreak	<i>Mitoura rosneri rosneri</i>			x	x	x	x	x	x							Host Plant: western red cedar
Gray Hairstreak	<i>Strymon melinus atrofasciatus</i>							x								Host Plant: pea family, beans
Western Spring Azure	<i>Celastrina echo echo</i>		x					x	x		x	x	x		x	Host Plant: ocean spray, red osier dogwood, ceanothus, hardhack
Silvery Blue	<i>Glaucopsyche lygdamus columbia</i>							x								Host Plant: lupines, vetch, wild pea
Zerene Fritillary	<i>Speyeria zerene bremnerii</i>							x	x							Host Plant: violt speceas
Hydaspe Fritillary	<i>Speyeria hydaspe rhodope</i>		x	x	x	x	x	x	x		x	x			x	Host Plant: native violets
Mylitta Crescent	<i>Phyciodes mylitta</i>							x	x							Host Plant: Canada thistle
Satyr Anglewing	<i>Polygonia satyrus</i>		x	x		x	x	x	x						x	Host Plant: stinging nettle
GreenComma	<i>Polygonia faunus</i>		x	x		x	x	x	x						x	Host Plant: willow, alder, birch
Oreas Anglewing	<i>Polygonia oreas silenus</i>		x	x		x	x	x	x						x	Host Plant: curant speceas
Zephyr Anglewing	<i>Polygonia zephyrus</i>		x	x		x	x	x	x						x	Host Plant: native currants
Compton Tortoiseshell	<i>Nymphalis vaualbum</i>		x	x		x	x	x	x						x	Host Plant: birch, willow, poplar
California Tortoiseshell	<i>Nymphalis californica</i>							x	x							Host Plant: ceanothus
Mourning Clock	<i>Nymphalis antiopa</i>		x	x	x	x	x	x	x						x	Host Plant: willow, elm, cottonwood
Milbert's Tortoiseshell	<i>Aglais milberti</i>			x		x	x	x	x						x	Host Plant: stinging nettle
Painted Lady	<i>Vanessa cardui</i>							x	x							Host Plant: thistles, borage, composites, mallows
West Coast Lady	<i>Vanessa annabella</i>							x	x							Host Plant: stinging nettle, sidalceas, globemallow, mallows
Red Admiral	<i>Vanessa atalanta</i>		x	x		x	x	x	x		x				x	Host Plant: stinging nettle, false nettles, hops
Lorquin's Admiral	<i>Limenitis lorquini ilgae</i>		x	x		x	x	x	x							Host Plant: willows, poplars, aspen, cottonwood, chokecherry, hardhack
Woodland Skipper	<i>Ochlodes sylvanoides</i>							x	x						x	Host Plant: grasses, reed canary grass
Monarch	<i>Danaus plexippus</i>							x	x							Host Plant: milk weed

Appendix G – Case Studies for Biodiversity Checklist

Case study

LANDSCAPE PROGRAMME (BERLIN, GERMANY)

Berlin's *Landscape Programme* was initiated in the late 1980s and formally approved in 1994. It includes strategies to protect ecosystems, wildlife, and landscapes, encourage recreation and support mitigation efforts. The *Programme* was a response to counter rapid high-density development in the inner city. Landscape Program is implemented through landscape plans, which cover a portion of Berlin's urban area.³

Biotope development zones were established that consider different habitats and the cultural and historical development of the City, with each zone having specific planning objectives. Other goals include protection of valuable areas, preservation of open space, habitat connectivity and integration of biotopes and species protection into land use. Protected areas will be incorporated into a regional framework.³

The *Biotope Area Factor* (BAF) was developed to promote quality, high density urban development while incorporating green infrastructure. The BAF sets an ecological objective that can be achieved by incorporating different elements of 'green space'. Each element is given a weighting factor based on its ecological effectiveness. This permits developers some flexibility to achieve objectives. In addition, the proportion of 'green space' will vary by development type (e.g. residential, commercial, public facility). Objective is to maintain high density while incorporating green infrastructure.¹

$$\text{BAF} = \frac{\text{ecologically-effective surface areas}}{\text{total land area}}$$

Weighting factors for different surface types:²

- sealed (impermeable surfaces) - 0.0
- permeable to water and air, but no plant growth - 0.3
- green vertical areas - 0.5
- green roofs - 0.7
- surfaces with vegetation connected to soil below - 1.0

REFERENCES

1. Kazmierczak, A. and Carter J. (2010) Adaptation to climate change using green and blue infrastructure. A database of case studies.
2. Landschaft Planen & Bauen and Becker Giseke Mohren Richard. The Biotope Area Factor as an Ecological Parameter (1990). http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/download/Auszug_BFF_Gutachten_1990_eng.pdf
3. Berlin Senate Department for Urban Development and the Environment http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/index_en.shtml

Case study

Bo01 (MALMO, SWEDEN)

Bo01 was a new residential district constructed as part of an international housing competition in 2001. 600 residences, housing 1000 people, were built on 9 hectares of what was once an industrial brownfield.¹

Specific goals for the development were to incorporate green infrastructure, promote biodiversity, and minimize stormwater. The City chose to implement an open stormwater system, with impermeable surfaces compensated by green space. A *Green Space Factor* (based on Berlin's *Biotope Area Factor*) was developed to help meet these goals. Developers were also required to choose *Green Points* to meet specific biodiversity and stormwater management objectives.³

Sub-areas (surface types) within the development site were ranked on a scale of 0 to 1 based on opportunity for vegetation, ecology and stormwater management. More functional 'green space' is given a higher weighting. The average value of 'green space' must be 0.5 or greater. Layering was also permitted; for example, shrubs underneath a tree canopy could be double counted for the same sub-area.³

$$\text{GSF} = \frac{(\text{area A} \times \text{factor A}) + (\text{area B} \times \text{factor B}) + (\text{area C} \times \text{factor C}) + (\text{etc.})}{\text{total courtyard area}}$$

Weighting factors for different surface types:¹

- sealed (impermeable surfaces) - 0.2
- green vertical areas - 0.7
- climbing plants - 0.2
- green roofs - 0.8
- garden plot - 0.5
- open water - 1.0

Green Points were implemented to support specific aspects of biodiversity that may not be accounted for by the GSF. Developers had to select to incorporate into plan. Examples include: bird boxes, bat boxes, fruit-bearing trees, native plants, green courtyards that do not require mowing, and treatment and re-use of greywater.³

REFERENCES

1. Kazmierczak, A. and Carter J. (2010) Adaptation to climate change using green and blue infrastructure. A database of case studies.

2. Greenstructure and Urban Planning. Website. <http://www.greenstructureplanning.eu/scan-green/bo01.htm>

3. Kruuse, Annika. GRaBS Expert Paper 6: The green space factor and the green points system <http://www.grabs-eu.org/downloads/EP6%20FINAL.pdf>

Case study

GREEN FACTOR (SEATTLE, UNITED STATES)

The *Seattle Green Factor* (SGF) was adopted as a green development standard for commercial zones in 2006. It has been expanded to include development in industrial commercial, south downtown, and multifamily residential zones.¹ It is designed to increase and improve green (landscaped) areas while also meeting objectives for biodiversity, climate change adaptation, stormwater management, and livability. In 2010, the *Seattle Green Factor* was given an Honor Award by the American Society of Landscape Architects (ASLA).²

The SGF reduced open space requirement and replaced it with environmentally beneficial landscaping. Each square foot development is awarded points based on specific landscape elements (e.g. plantings, water features, green roofs, permeable paving). A minimum score must be achieved which varies according to zone. For example, Commercial zones must reach 0.30 (30% of footprint), whereas Midrise and Highrise zones must achieve 0.50.¹

$$\text{SGF} = \frac{(\text{area of element A} \times \text{factor A}) + (\text{area of element B} \times \text{factor B}) + (\text{etc.})}{\text{area of property}}$$

Weighting factors for different surface types:¹

- Mulch, ground covers, or other plants <2' tall at maturity
- Tree canopy for "small tree" (canopy spread 8' to 15') - 0.3
- Permeable paving over at least 24" of soil or gravel - 0.5
- Vegetated wall - 0.7
- Tree canopy for preservation of large existing tree - 0.8

Additional incentives for developers are also provided by the SGF:¹

- Landscaping in contiguous right-of-ways count towards score; given and bonus credit;
- Landscaping visible to public, can be used for food cultivation, or includes drought-tolerant native species is
- Vegetation can be layered for additional credit, which provides more ecological value.

REFERENCES

1. Seattle Department of Planning and Development. Seattle Green Factor. Website. <http://www.seattle.gov/dpd/permits/greenfactor/Overview/>

2. American Society of Landscape Architects. Website. <http://www.asla.org/2010awards/519.html>

Appendix H – Selection Criteria for Indicator Species



Picoides pubescens Downy Woodpecker by Dean O'Dea

1. Species should not be a habitat generalist (i.e., should not be so adaptable that it occurs regularly in a variety of habitat types and conditions);
2. Species should not be overly influenced by conditions outside the Management Area. Conditions include:
 - land use practices, harvesting, or climatic or oceanic conditions in a disjunct location (e.g., in wintering or breeding areas of long-distance bird migrants that breed or winter, respectively, in the management area; in ocean habitats of anadromous fish);
 - home ranges (either breeding or wintering) that are larger than the physical habitat areas available in the Management Area, so that the success of the species within the area depends, in part, on conditions in nearby areas that are outside the manager's control.
3. Species should be common enough (and the surveyed habitats large enough), that a statistically significant sample can be obtained.
4. Species characteristics (e.g., behaviour, visibility) should be suited to simple, relatively inexpensive survey techniques.

**Species may also represent an unhealthy state of the habitat, rather than a healthy one, as a measure of habitat degradation (e.g., invasive species, whether native or alien, or pollution tolerant species). This is suitable only if the species does not occur in "significant" numbers in the healthy state, and can be eliminated by proper habitat management (rather than by direct management of the unwanted species).

There should be scientifically verifiable evidence that the indicator species will respond quickly to changes in habitat quality.

*Deviations from point 2 can, and may have to be, accommodated by using appropriate survey techniques, namely, by setting up a survey program that uses reference areas. Reference areas could be located in other Management Class areas. Ideally, fixed survey areas established in all Management Class (MC) areas and always surveyed the same years will serve as both monitoring sites for that MC area and reference sites for other MC areas. Thus, any changes in the numbers of a species that are regional in scale will be detected across all survey sites in which they occur, and not be confused with changes that may be the result of management choices in one MC area.

***"Significant" is in quotations in point 5 to distinguish it from the statistical term. Also, in aquatic systems there may be microorganisms or other species whose numbers are considered significant once their numbers exceed certain densities, e.g., numbers/litre.

Appendix I – The City Biodiversity Index Indicators, Methods and Scoring

NUMBER	INDICATORS	DEPARTMENTS	SCORING RANGE
1	Proportion of natural areas in City	$(\text{Total area of natural areas})/(\text{Total area of city})$	0 pt: <0.01 1 pt: 0.01-0.06 2 pt: 0.07-0.13 3 pt: 0.14-0.20 4 pt: >0.20
2	Connectivity measures or ecological networks to counter fragmentation	$(\text{Total area of natural areas that are linked})/(\text{Total area of natural areas})$	0-2
3	Native biodiversity in built-up areas (bird species)	# native bird species in built-up areas	0-2
4	Change in number of native vascular plants	Total increase in number of species (as a result of re-introduction, rediscovery, new species found, etc.) minus number of species that have been extirpated	0 pt: 0 species or less
5	Change in number of native birds		1 pt: 1 species
6	Change in number of native butterflies		2 pt: 2 species
7	Change in number of native (choose representative taxonomic group)		3 points: 3 species
8	Change in number of native (choose representative species)		4 points: 4 species or more
9	Proportion of Protected Natural Areas	$(\text{Area of protected or secured natural areas})/(\text{Total area of city})$	0-2
10	Proportion of Invasive Alien Species	$(\# \text{ invasive alien species})/(\# \text{ native species})$	0 pt: >0.30 1 pt: 0.21-0.30 2 pt: 0.11-0.20 3 pt: 0.01-0.10 4 pt: <0.01
11	Regulation of quantity of water	$(\text{Total permeable area})/(\text{Total terrestrial area of the city})$	0-2
12	Climate regulation: carbon storage and cooling effect of vegetation	$(\text{Tree canopy cover})/(\text{Total terrestrial area of the city})$	0-2
13	Recreational Services	$(\text{Area of parks with natural areas and protected or secured natural areas})/1000 \text{ persons}$	0 pt: <0.1ha/1000pp 1 pt: 0.1-0.3ha/1000pp 2pt: 0.4-0.6ha/1000pp 3pt: 0.7-0.9ha/1000pp 4pt: >0.9ha/1000pp
14	Educational Services	Number of formal educational visits per child below 16 years to parks with natural areas or protected or secured natural areas per year	0 pt: 0 visits/a 1 pt: 1 visit/a 2 pt: 2 visits/a 3 pt: 3 visits/a 4 pt: 4 visits/a

Table 31. City Biodiversity Index Indicators, Methods and Scoring

NUMBER	INDICATORS	DEPARTMENTS	SCORING RANGE
15	Budget allocated to biodiversity	(Amount spent on biodiversity related administration)/(Total budget of city)	0-2
16	Number of biodiversity projects implemented by the city annually	# of biodiversity related projects	0-2
17	Rules, regulations and policy – existence of local biodiversity strategy and action plan	Status of Local Biodiversity Strategy and Action Plan; number of associated CBD initiatives	0 pt: No Plan 1 pt: 2 pt: 3 pt: 4 pt:
18	Institutional Capacity	Number of essential biodiversity-related functions	1 pt: 1 function 2 pt: 2 functions 3 pt: 3 functions 4 pt: >3 functions
19	Institutional Capacity	Number of City or local government agencies involved in inter-agency cooperation pertaining to biodiversity matters	0 pt: 1 or 2 agencies 1 pt: 3 agencies 2 pt: 4 agencies 3 pt: 5 agencies 4 pt: >5 agencies
20	Participation and Partnership	Existence and state of formal or informal public consultation process pertaining to biodiversity-related matters	0 pt: no process 1 pt: considered 2 pt: planned 3 pt: being implemented 4 pt: exists
21	Participation and Partnership	Number of agencies/private companies/NGOs/academic institutions/international organizations with which the City is partnering in biodiversity activities, projects and programs	0 pt: 0 partnerships 1 pt: 1-6 partnerships 2 pt: 7-12 partnerships 3 pt: 13-19 partnerships 4 pt: 20 or more
22	Education and Awareness	Is biodiversity or nature awareness included in school curriculum?	0 pt: not covered 1 pt: considered 2 pt: planned 3 pt: being implemented 4 pt: included
23	Education and Awareness	Number of outreach or public awareness events held in the City per year	0 pt: 0 events 1 pt: 1-59 events 2 pt: 60-149 events 3 pt: 150-300 events 4 pt: >300 events

Table 31. City Biodiversity Index Indicators, Methods and Scoring

Appendix J – Green Infrastructure Network Corridors, Hubs and Sites

The following tables summarize the condition and recommendations for the corridors and proposed hubs identified in the Green Infrastructure Network. Table 33 provides an inventory of corridors. Table 34 provides an inventory of existing and proposed hubs as well as a number of high priority sites to be considered for protection.

CORRIDOR OR HUB/SITE ID	<p>Corridors are labeled as numbers;</p> <p>Proposed Hubs/sites are labeled as a letter;</p> <p>Hubs are >10ha in size;</p> <p>Protected Hubs/sites are identified with the park name.</p>
RISK OF DEVELOPMENT	<p>High: Habitat that is poorly protected in existing policy and may be at risk of development in the short term.</p> <p>Medium: Includes areas that may be partially protected as park or riparian setback areas. May be partially at risk of development.</p> <p>Low: Includes areas that are protected as park, riparian areas or undevelopable areas (ie. floodplain, unstable slopes). Generally not at risk of development in the short term.</p>
ECOLOGICAL VALUE	<p>High: Important habitat that is considered a critical component of the Green Infrastructure Network. Includes major pinch points or barriers to connectivity. May support significant wildlife communities and/or species at risk.</p> <p>Medium: Important habitat that enhances connectivity and supports significant wildlife communities.</p> <p>Low: Moderately important habitat that supports the GIN and can benefit from enhancement and restoration. Highly fragmented and influenced by adjacent urban development.</p>
CORRIDOR	<p>Regional: Major corridors between 50 and 100 metres in width; naturalized and designed to provide movement for a wide range of species.</p> <p>Local: Corridors and greenways between 10 and 50 metres in width; designed to provide movement for species more adapted to urban environments.</p>
TARGET WIDTH	<p>The recommended width of corridor in metres</p>

Table 32. Criteria and terms used for GIN management recommendations

ID	RISK OF DEVELOPMENT	ECOLOGICAL VALUE	CORRIDOR TYPE	TARGET WIDTH (M)	RECOMMENDATIONS
1	Low	High	Regional	100	Steep unstable slope. Includes important marine foreshore riparian habitat. Forested with a mix of species and age classes. Includes some mature trees of significant size. Railway runs along the based on the slope. Connected to Kwomais Point Park. Low risk to development as slopes are undevelopable due to geotechnical instability. Expand natural area above top of bank through naturesscaping to allow for wildlife movement above the steep slopes.
2	Moderate	Moderate	Regional	50	Moderately disturbed natural area adjacent to railway between established residential development. Connects ocean foreshore to Blackie Spit. North portion protected as park. Protect and enhance remaining natural areas. Restrict human access. Traffic calming and signage for crossing at Beecher Street.
3	Low	Low	Local	10	Foreshore beach area that is highly impacted by recreation. Connects Blackie Spit to additional foreshore habitat. Fence off and restore native foreshore plant communities in certain areas. Install hedgerow corridor along greenway.
4	Moderate	High	Regional	50	Foreshore riparian habitat at headwaters of the Nicomekl River. Mostly private land with fragmented patches protected as park. Connects Blackie Spit with Elgin Heritage Park. Work with adjacent landowners to naturalize private land and remove barriers to movement.
5	Low	Moderate	Regional	50	Riparian corridor mostly protected as park. Work with adjacent landowners to naturalize private land and remove barriers to movement. Traffic calming and signage for crossing at Crescent Rd.
6	Low	Moderate	Regional	30	Narrow protected corridor connecting Huntington Park to Crescent Park. Work with adjacent landowners to naturalize private land and remove barriers to movement. Traffic calming and signage for crossing at 24 Ave.
7	Low	High	Regional	50	Linear network of protected natural areas. Connects Sunnyside Acres, Dogwood and Crescent Parks. Work with adjacent landowners to naturalize private land and remove barriers to movement. Traffic calming and signage for crossing at 140 St. Enhance the narrow corridor between 140 St and 139A St.
8	Moderate	Moderate	Regional	50	Riparian Corridor along Chantrell Creek. Connects Elgin Heritage Park to upland areas. Partially protected as parkland. Work with adjacent landowners to naturalize private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage for crossing at 24 Ave. 28 Ave and Crescent Rd.
9	Moderate	Moderate	Local	30	Natural forest patches that connect Elgin Heritage Park and Elgin Creek Park. Partially protected as network of parks. Protect and enhance remaining natural areas. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossing at 144 St and Crescent Rd.
10	Moderate	Moderate	Regional	50	Riparian Corridor along Elgin Cr. Mostly protected in network of parks. Connects Sunnyside Acres to Nicomekl foreshore. Work with adjacent landowners to naturalize private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage for crossings at 24 Ave. and 32 Ave and Crescent Rd.
11	Low	Low	Local	30	Narrow protected corridor. Work with adjacent landowners to naturalize private land and remove barriers to movement. Traffic calming and signage for crossing at 144 St.
12	Low	Low	Local	30	Narrow protected corridor. Work with adjacent landowners to naturalize private land and remove barriers to movement. Traffic calming and signage for crossing at 144 St.
13	Moderate	Moderate	Regional	50	Network of protected areas and riparian corridors. Connects Sunnyside Acres to Nicomekl foreshore. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage for crossings at 28 Ave. and 32 Ave. and King George Bvd. Consider wildlife passage under King George Bvd.
14	Low	Low	Local	20	Semiahmoo Trail Greenway. Provides connectivity between Sunnyside Acres and Nicomekl foreshore. Naturalize trail edges. Work with adjacent landowners to naturalize private land and remove barriers to movement. Traffic calming and signage for crossing at 28 Ave, 32 Ave, and 34 Ave.
15	Moderate	High	Regional	30	Golf course and subdivision bordering the Nicomekl River. Provides critical east to west movement along the Nicomekl river foreshore. Establish hedge row and enhance tree cover along foreshore. Encourage naturesscaping on golf course. Improve wildlife passage corridor under Elgin Rd. Bridge.
16	High	High	Regional	50	Undisturbed forested riparian habitat. Provides critical east to west movement along the Nicomekl River foreshore. Protect land within 50m of foreshore. Improve wildlife passage under Elgin Rd. Bridge and King George Bvd Bridge.
17	Moderate	High	Regional	30	Golf course and subdivision bordering the Nicomekl River. Provides critical east to west movement along the Nicomekl River foreshore. Establish hedge row and enhance tree cover along foreshore. Encourage naturesscaping on golf course. Improve wildlife passage under King George Bvd Bridge and Hwy 99 Bridge.

ID	RISK OF DEVELOPMENT	ECOLOGICAL VALUE	CORRIDOR TYPE	TARGET WIDTH (M)	RECOMMENDATIONS
18	Moderate	Moderate	Regional	50	Riparian corridor partially protected in parks. Connects Sunnyside Acres to Nicomekl foreshore. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage for crossing at King George Blvd. Consider wildlife passage under King George Blvd.
19	Low	Low	Local	30	Hydro right of way adjacent to Hwy 99. Establish hedgerows and shrub pockets. Create wetlands in lowland areas. Traffic calming and signage at 32 Ave.
20	Low	Low	Local	60	Riparian area for Barbara Creek. Provides local connectivity upland from foreshore. Mostly protected as park. Protect land adjacent to riparian setback in north portion of corridor.
21	Moderate	Moderate	Local	60	Riparian corridor in natural area proposed for development. Includes creeks and lake foreshore. Provides connectivity from Highway 99 greenway east to the ALR. Protect land adjacent to riparian setback. Naturalize riparian habitat adjacent to lake. Establish shrub habitat under Hydro ROW. Traffic calming and signage for crossings at 32 Ave
22	Moderate	Moderate	Local	60	Riparian corridor through golf course and residential area. Enhance riparian habitat. Naturescaping on golf course. Traffic calming and signage for crossings at 32 Ave
23	Low	Low	Local	20	Greenway adjacent to Hwy 99. Provides only continuous movement corridor north to south through highly developed neighbourhoods. Install highway fencing. Traffic calming and signage along all adjacent and intersecting roadways. Improve wildlife passage under 24 Ave.
24	Moderate	Moderate	Local	40	Greenway running adjacent to Hwy 99 through undeveloped natural area. Provides connectivity to proposed Hub F. Install highway fencing. Improve wildlife passage under 16 Ave.
25	High	Low	Local	20	Fragmented natural forested habitat through area that is planned for development. Follows planned greenways and parks. Provides limited connectivity through developed neighbourhood. Naturalize edges of planned greenways. Traffic calming and signage at 16 Ave, 20 Ave.
26	High	Low	Local	20	Fragmented natural areas through area that is planned for development. Follows planned greenways. Provides limited connectivity through developed neighbourhood. Naturalize edges of planned greenway. Traffic calming and signage at 24 Ave, 28 Ave and 164 St.
27	High	Moderate	Local	30	Riparian corridor for creek through natural forested area. Provides connectivity to ALR. Protect land adjacent to riparian setback. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings along 32 Ave.
28	High	Moderate	Local	30	Fragmented natural areas through area that is planned for development. Includes two large unprotected forest patches. Follows planned greenways. Provides limited connectivity through developed neighbourhood. Naturalize edges of planned greenway. Traffic calming and signage at road crossings.
29	Moderate	Moderate	Local	30	Edge buffer for ALR. Includes fragmented natural areas. Provides important edge habitat to ALR field habitat. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage along 32 Ave and at 176 St.
30	Moderate	High	Regional	50	Edge buffer for ALR. Includes large natural forested habitat proposed for protection as Hub H. Provides important edge habitat to ALR field habitat. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage for crossings at 184 St.
31	High	High	Regional	50	Natural forested areas in low density residential area. Planned for redevelopment. Establish forested corridor that will provide safe wildlife movement between Redwood Park and proposed Hub H. Traffic calming and signage for crossings at 24 Ave and 20 Ave.
32	Moderate	Moderate	Regional	50	Edge buffer for ALR. Includes fragmented natural areas. Provides connectivity between Redwood Park and proposed Hub F. Provides important edge habitat to ALR field habitat. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage for crossings at 16 Ave and 176 St.
33	High	Moderate	Regional	50	Edge buffer for ALR. Highly disturbed area through low density residential area. Runs adjacent to 168 St. Provides important edge habitat to ALR field habitat. Expand on existing hedgerow and protect a forested corridor adjacent to 168 St. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings along 168 St.
34	High	High	Regional	100	Riparian corridor within proposed Hub F. Supports species at risk. Enhance/expand riparian habitat. Traffic calming and signage for crossings at 16 Ave and 168 St.
35	High	High	Regional	100	Riparian corridor within proposed Hub F. Supports species at risk. Enhance/expand riparian habitat. Traffic calming and signage for crossings at 16 Ave.
36	Moderate	High	Local	50	Riparian corridor for McNally Creek. Partially protected as network of parks. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage for crossings at 10 Ave and 8 Ave.

ID	RISK OF DEVELOPMENT	ECOLOGICAL VALUE	CORRIDOR TYPE	TARGET WIDTH (M)	RECOMMENDATIONS
37	Moderate	High	Regional	100	Riparian corridor for Fergus Creek. Includes large natural forested area. Provides habitat for species at risk. Provides connectivity from proposed Hub F to the Little Campbell River system. Protect land adjacent to riparian setback. Work with golf course to enhance natural habitat. Traffic calming and signage for crossings at 8 Ave.
38	Low	Low	Local	30	Riparian corridor for Sam Hill Creek. Highly disturbed riparian habitat through agricultural fields. Provides movement through the ALR. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage at 176 St.
39	Low	Low	Local	30	Riparian corridor for Thomson Creek. Highly disturbed riparian habitat through agricultural fields. Provides movement through the ALR and connectivity north to Redwood Park. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback.
40	High	Moderate	Regional	100	Riparian habitat for the primary reach of the Little Campbell River. Fragmented natural areas. Provides scattered high value wetland communities. Provides movement through the ALR. Protect land adjacent to riparian setback. Naturalize all areas within natural floodplain. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Work with golf course to enhance natural habitat. Traffic calming and signage at 8 Ave, 16 Ave, 20 Ave and 184 St.
41	Moderate	High	Regional	100	Riparian habitat for the primary reach of the Little Campbell River. Fragmented natural areas. Provides scattered high value wetland communities. Provides movement through the ALR. Protect land adjacent to riparian setback. Naturalize all areas within natural floodplain. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Work with golf course to enhance natural habitat. Traffic calming and signage at 176 St.
42	Moderate	Moderate	Regional	60	Riparian habitat for creeks including Kuhn and Theodore Creeks. Highly disturbed by agriculture development and a golf course. Include one large forested patch. Provides movement through the ALR to proposed Hub E and south to natural areas of Washington State. Protect land adjacent to riparian setback. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Work with golf course to enhance natural habitat. Traffic calming and signage at 184 St.
43	Moderate	High	Regional	50	Riparian habitat for creek running adjacent to 188 St. Runs through a large forested patch that is proposed for protection as Hub E. Provides movement through the ALR south to natural areas of Washington State. Protect land adjacent to riparian setback. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage along 188 St.
44	Moderate	High	Regional	100	Riparian habitat for Jenkins creek. Mostly forested and natural. Provides movement south to natural areas of Washington State. Protect land adjacent to riparian setback. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement.
45	High	Moderate	Regional	100	Large natural forested area. Connects riparian corridors of Jenkins and Jacobson creeks. Provides connectivity east towards Campbell Valley Regional Park. Protect this area as a park through acquisition. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage at 8 Ave.
46	Moderate	Moderate	Local	60	Riparian corridor for Highland Creek. Highly disturbed riparian area with fragmented natural areas. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage at 192 St and 8 Ave.
47	Moderate	Moderate	Corridor	100	Riparian habitat for Jacobsen Creek. Includes fragmented natural areas including one park. Sections are highly disturbed by agriculture development. Provides connectivity east towards Campbell Valley Regional Park. Protect land adjacent to riparian setback. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage at 8 Ave.
48	Moderate	Moderate	Local	60	Riparian corridor for Jacobson Creek. Mostly natural forested habitat. Provides connectivity east towards Campbell Valley Regional Park. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback.
49	High	High	Regional	100	Riparian habitat for the Little Campbell River. Not within the ALR. Runs through continuous forested areas. North portion proposed to be protected as Hub I. Protect land adjacent to riparian setback. Naturalize all areas within natural floodplain. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage at 16 Ave.
50	Moderate	High	Regional	100	Riparian habitat for the Little Campbell River. Fragmented natural areas. Includes one small protected park. Provides movement through the ALR. Protect land adjacent to riparian setback. Naturalize all areas within natural floodplain. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage at 184 St.
51	Moderate	Moderate	Local	60	Riparian corridor for Twins Creek. Highly disturbed riparian area with fragmented natural areas. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback. Traffic calming and signage at 184 St and 16 Ave.

ID	RISK OF DEVELOPMENT	ECOLOGICAL VALUE	CORRIDOR TYPE	TARGET WIDTH (M)	RECOMMENDATIONS
52	Moderate	High	Regional	60	Riparian corridor for tributary of Little Campbell River. Partially protected as park. Provides movement east to west south of the Campbell Heights industrial area. East portion proposed to be protected as Hub I. Traffic calming and signage at 192 St.
53	Moderate	High	Regional	50	Edge buffer for ALR. Includes fragmented natural areas. Follows 184 St. Provides connectivity from Redwood Park north to proposed Hub H and G. Provides important edge habitat to ALR field habitat. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage along 184 St.
54	Moderate	Moderate	Regional	100	Edge buffer for ALR. Runs through a large patch of young forest with scattered fields. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage along 20 Ave and 24 Ave.
55	Low	High	Regional	70	Riparian corridor for tributary of Little Campbell River. Protected as Park. Connects proposed Hub I with Latimer Lake. Currently being restored to a natural plant community. Traffic calming and signage at 24 Ave.
56	Moderate	High	Regional	100	Mature forest habitat adjacent to the Surrey Langley border. Includes riparian habitat at the south end. Provides connectivity to the natural areas of Langley to the east. This land is owned by the City.
57	Moderate	Moderate	Regional	50	Riparian area for Erickson Creek and partially forested area providing critical east to west connectivity across the ALR. Protect this area as a park through acquisition.
58	Moderate	High	Regional	100	Large forested natural area. Follows edge of ALR and runs through proposed Hub G. This forested area provides an important north south wildlife movement corridor. Protect as much of this forested corridor as possible. Traffic calming and signage at 40 Ave, 32 Ave and 24 Ave.
59	Moderate	High	Regional	100	Large forested natural area. Follows edge of ALR and runs through proposed Hub B. This forested area provides an important north south wildlife movement corridor. Provides important edge habitat to ALR field habitat. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage at 192 St.
60	Moderate	Moderate	Regional	60	Riparian corridor for Armstrong Creek. Forested patches fragmented by agricultural fields and residential development. Connects proposed Hub G to the Nikomekl River. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Protect land adjacent to riparian setback.
61	Moderate	High	Regional	60	Riparian corridor for the Nicomekl River. This entire reach is dyked for flood control. This riparian area provides one of the only feasible corridors running through the ALR. Enhance riparian habitat within 30m of river by planting tree and shrub cover. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Improve wildlife passage at Highway 99 and Highway 15. Traffic calming and signage at all arterial roads.
62	Low	Moderate	Regional	60	Riparian corridor along a dyked stream. Provides connectivity between the Nicomekl River and Mound Farm Park. Protect land adjacent to riparian setback. Naturalize this area by planting native tree and shrub cover. Traffic calming and signage at 48 Ave.
63	Moderate	Low	Secondary	30	Riparian area for ditch connecting to the Nicomekl River. Highly disturbed for agriculture. Protect land adjacent to riparian setback and restore tree and shrub cover. Traffic calming and signage at 40 Ave and 32 Ave.
64	Low	Moderate	Regional	60	Riparian corridor along roadside ditch. Provides connectivity between Serpentine River and Mound Farm Park. Protect land adjacent to riparian setback. Naturalize this area by planting native tree and shrub cover. Traffic calming and signage at 168 St and 164 St.
65	Low	High	Regional	60	Riparian corridor for the Serpentine River. This entire reach is dyked for flood control. This riparian area provides one of the only feasible corridors running through the ALR. Enhance riparian habitat within 30m of river by planting tree and shrub cover. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Improve wildlife passage at Highway 99, King George Blvd, Hwy 10, Fraser Hwy, Highway 15. Traffic calming and signage at all arterial roads.
66	Moderate	High	Regional	60	Riparian area of Nicomekl River. Provides last remaining and critical movement corridor between the ALR to the east and natural areas in Sunnyside MU. Protect and enhance remaining natural areas. Improve wildlife passage under Hwy 99 bridge. Traffic calming and signage for crossings at 152 St and 40 Ave.
67	Moderate	Low	Secondary	30	Riparian area for Class A ditch connecting to the Serpentine river. Highly disturbed for agriculture. Protect land next to riparian setback and restore tree and shrub cover. Traffic calming and signage at Colebrook Rd. Provides connectivity from the Serpentine River north toward Colebrook Park.
68	Moderate	Moderate	Local	50	Fragmented natural areas. Portions follow riparian setbacks of constructed ditches. Next to golf course. Provides connectivity between Colebrook Park and the Serpentine River. Improve wildlife passage at King George Blvd and Colebrook Rd.
69	Low	Moderate	Local	30	Riparian area for Peacock brook. Highly disturbed for agriculture. Provides connectivity between Serpentine River and Colebrook Park. Protect land adjacent to riparian setback. Restore tree cover along riparian area and provide a movement corridor under Highway 99.

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70	Moderate	High	Regional	100	Ocean foreshore riparian area. A railway runs along this coastline with scattered shrub communities. This riparian habitat provides a critical interface to the intertidal wetlands and shallow waters of Mud Bay. Protect this land through acquisition or protective covenants. Increase tree and shrub cover. Work with adjacent landowners to remove barriers to movement.
71	High	Moderate	Regional	50	Edge buffer for ALR. Includes fragmented natural areas. Provides connectivity between Joe Brown and Colebrook Parks. Provides important edge habitat to ALR field habitat. Establish and protect a forested corridor on perimeter of the ALR.
72	Low	Moderate	Local	50	Hydro right of way. Highly developed with fragmented natural habitat. Numerous barriers to travel. It provides a continuous corridor throughout an established neighbourhood. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Install hedgerows along trails. Traffic calming and signage at road crossings. Provide wildlife passage at Highway 10.
73	Moderate	High	Local	60	Riparian area for Cougar Creek. Provides connectivity to Delta watershed park. Partly protected as park. Protect land adjacent to riparian setback. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement.. Traffic calming and signage for crossings at 120 St.
74	Low	Moderate	Local	50	Hydro right of way. Highly developed with fragmented natural habitat. Some greenways exist. Numerous barriers to travel. It provides a continuous corridor throughout an established neighbourhood. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Install hedgerows along trails. Traffic calming and signage at 80 Ave, 76 Ave, 72 Ave, 68 Ave and 64 Ave. Provide wildlife passage at Highway 10.
75	Moderate	Moderate	Local	60	Riparian area for Archibald Creek. Partly protected as park. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings at 144 St, 148 St, 152 St.
76	Moderate	Moderate	Local	60	Riparian area for Hyland Creek. Partly protected as park. Provides connectivity to the Serpentine River. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings at 144 St, 148 St, 152 St.
77	Moderate	Moderate	Local	60	Riparian area of lowland dyked portion of Hyland Creek. Highly disturbed by agriculture. Protect land adjacent to riparian setback. Establish a native shrub community in riparian zone. Traffic calming and signage along 64 Ave.
78	Moderate	Moderate	Regional	60	Riparian area for lower Bear Cr. This reach is dyked and heavily impacted by agriculture. Provides connectivity from Surrey Lake Park to the Serpentine River. Protect land adjacent to riparian setback and restore tree and shrub cover.
79	Moderate	High	Local	30	Riparian area for ditch running across Hydro right of way. Provides connectivity between Fleetwood Park and Surrey Lake Park.
80	Moderate	Moderate	Local	50	Edge buffer for ALR. Includes fragmented natural areas. Provides important edge habitat to ALR field habitat. Connects to Fleetwood park. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage along 160 St.
81	High	Moderate	Local	15	Greenway to be established through redevelopment. Provides connectivity west from Fleetwood Park. Retain mature trees where possible and naturalize edges of planned greenway.
82	Moderate	Moderate	Local	30	Riparian area of Dyked tributary of the Serpentine River. Highly disturbed for agriculture. Protect land adjacent to riparian setback. Naturalize this area by planting native tree and shrub cover. Traffic calming and signage along 168 St.
83	Moderate	Moderate	Regional	60	Riparian area for Bear Creek. This area runs through a golf course with fragmented forest and shrub communities. Work with golf course to enhance natural habitat Improve wildlife passage at 152 St.
84	Low	High	Regional	100	Riparian area for Bear Creek. Mostly protected as park. Includes high value aquatic and riparian habitat. Work with adjacent landowners to naturalize this area and remove barriers to movement. Traffic calming and signage for crossings at 140 St and 144 St.
85	Low	Moderate	Local	60	Riparian area for creek. Mostly protected as park. Work with adjacent landowners to naturalize this area and remove barriers to movement.
86	Low	High	Regional	100	Hydro right of way. Provides a network of shrub and field habitat. Mostly protected as a network of parks. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Traffic calming and signage for crossings at King George Blvd, 140 St, 144 St.
87	Low	Moderate	Local	60	Riparian area for creek. Mostly protected as park. Work with adjacent landowners to naturalize this area and remove barriers to movement.
88	Moderate	Moderate	Local	50	Hydro right of way. Partially protected as park. It provides a continuous corridor throughout an established neighbourhood. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Traffic calming and signage at 132 St.

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89	Moderate	Low	Local	60	Riparian area for Mahood Creek. Partly protected as park. Work with adjacent landowners to naturalize this area and remove barriers to movement. Traffic calming and signage at 128 St and 132 St.
90	Low	low	Local	30	Hydro Right of way through highly developed industrial area. Includes some riparian area. It provides a continuous corridor throughout a highly developed area. Work with landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Install hedgerows along trails. Traffic calming and signage at 88 Ave.
91	Moderate	Low	Local	60	Riparian area for creek. Mostly protected as park. Work with adjacent landowners to naturalize this area and remove barriers to movement. Traffic calming and signage at 88 Ave and 132 St.
92	Moderate	Moderate	Local	50	Hydro right of way. Partially protected as park. It provides a continuous corridor throughout an established neighbourhood. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Traffic calming and signage at 140 St, King George Blvd, 92 Ave, 132 St, 128 St and 88 Ave.
93	Low	Moderate	Local	60	Riparian area for Quibble Creek. Provides connectivity to Bear Creek Park. Mostly protected as park. Work with adjacent landowners to naturalize this area and remove barriers to movement. Traffic calming and signage for crossings at 92 Ave and 88 Ave.
94	Moderate	Moderate	Regional	60	Riparian area for King Creek. Mostly protected as park. Provides connectivity between Bear Creek and Green Timbers Parks. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings at 140 St and 88 Ave.
95	Moderate	Moderate	Local	60	Riparian area for Enver Creek. Mostly protected as park. Connects Bear Creek and Green Timbers Parks. Work with adjacent landowners to naturalize this area and remove barriers to movement. Traffic calming and signage for crossings at 84 Ave, 144 St, 88 Ave.
96	Moderate	Moderate	Local	60	Hydro right of way. This area is mostly field habitat in the yards of residential neighbourhoods. It provides a continuous corridor throughout an established neighbourhood. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Traffic calming and signage for road crossings. Traffic calming and signage at 96 Ave and Fraser Highway.
97	High	Moderate	Regional	50	This is a short but important connection between Green Timbers and the Hydro right of way corridor. Work to establish a naturalized connection in this vicinity. Traffic calming and signage for crossing 140 St and 100 Ave.
98	Moderate	Moderate	Regional	50	Hydro right of way including mostly residential yards. Provides connectivity through highly developed neighbourhood between Green Timbers Park and Hawthorne Park. Establish hedgerows and shrub pockets. Create wetlands in lowland areas. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossing at 104 Ave, 140 St and 100 Ave.
99	Moderate	Moderate	Local	50	Hydro right of way. This area is mostly field habitat in the yards of residential neighbourhoods. It provides a continuous corridor throughout an established neighbourhood. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Traffic calming and signage at 108 Ave.
100	Moderate	Moderate	Regional	100	Riparian area for Bon Accord creek. Partially protected as park. Connects Hawthorne Park and Invergarry Park. Protect land adjacent to riparian setback. Traffic calming and signage at 108 Ave. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement.
101	Moderate	Moderate	Local	50	Mostly protected as a network of park areas. Provides connectivity between Invergarry Park and Port Mann Park. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossing at Wallace Dr.
102	Moderate	High	Regional	100	Fragmented natural areas through residential neighbourhood. South Fraser Perimeter Road being complete to the north. Provides important connectivity between Invergarry Park and Port Mann Park. Facilitate wildlife passage under bridge. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement.
103	Moderate	Moderate	Regional	50	Fragmented natural areas and parks along slope break. Partially protected as park. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings at King George Blvd.
104	Moderate	Moderate	Regional	50	Fragmented natural areas and parks along slope break. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings at King George Blvd and Old Yale Rd.
105	Moderate	Moderate	Local	60	Riparian area for Ronson Cr. Mostly protected as park and riparian setbacks. Work with adjacent landowners to naturalize this area and remove barriers to movement.
106	Moderate	Moderate	Regional	50	Railway Right of way. Narrow and highly disturbed habitat. Runs through developed residential neighbourhood. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage for crossings at Old Yale Rd, 104 Ave, Scott Rd.

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107	Low	moderate	Local	60	Riparian area for Ronson Cr. Provides connectivity to Fraser River. Runs through highly developed industrial area. Increase tree cover in riparian area. Improve wildlife passage under South Fraser Perimeter Road.
108	Low	Moderate	Local	60	Riparian area for Scott Cr. Provides connectivity to Fraser River. Runs through highly developed industrial area. Increase tree cover in riparian area. Improve wildlife passage under South Fraser Perimeter Road.
109	Moderate	Moderate	Local	60	Riparian area for Scott Cr. Mostly protected as park and riparian setbacks. Work with adjacent landowners to naturalize this area and remove barriers to movement.
110	Moderate	Moderate	Regional	50	Fragmented natural areas and parks along slope break. Provides connectivity east to west above highly developed industrial area. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage at River Road.
111	Moderate	Moderate	Regional	60	Riparian area for Delta Cr. Mostly protected as park and riparian setbacks. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage at River Road.
112	Low	High	Regional	100	Forested natural area following the escarpment above South Fraser Perimeter road. Relatively steep with gullies. Includes Port Mann park and old land fill site. Mostly protected or unstable for development. Provides wildlife refuge areas and connects Surrey Bend west to Invegrary Park. Enhance old landfill site to expand on forested community. Consider strategic fencing to direct wildlife to underpass under the South Fraser Perimeter road connecting to Surrey Bend Park.
113	Low	High	Local	60	Riparian area for creek connecting south to Tynehead Park. Protected as park. Provides one of the few passages under Highway 1. Supports habitat for species at risk. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage along 104 Ave.
114	Moderate	High	Local	60	Riparian area for creek. Mostly forested. Provides habitat for species at risk. Restore and enhance riparian habitat. Traffic calming and signage along 102 Ave.
115	Low	Low	Local	30	This is a greenway that runs through highly developed neighbourhoods. Mostly mowed grass with few natural features. Provides the only available continuous connectivity east to west from Green Timbers Park to Tynehead Park. Establish hedgerows and shrub pockets along fencelines. Create wetlands in lowland areas. Traffic calming and signage at 152 St, 156 St, and 160 St.
116	Moderate	High	Regional	60	Riparian area for upper reach of Serpentine River. Field habitat extends into riparian area. Protect land adjacent to riparian setback and restore tree cover.
117	Low	High	Regional	60	Riparian corridor for Class A watercourse that provides southern connection to Tynehead Regional Park.
118	Moderate	Moderate	Regional	60	Riparian area for creek. Highly impacted from residential development. Provides connectivity from the Serpentine to Tynehead Regional Park. Protect and enhance land adjacent to riparian setback. Traffic calming and signage along 96 Ave.
119	Moderate	Moderate	Regional	50	Edge buffer for ALR. Includes fragmented natural areas. Provides important edge habitat to ALR field habitat. Provides connectivity between proposed Hub A and Tynehead park. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage along 92 Ave.
120	High	High	Local	50	Large forested site fragmented by low density residential development. Area is planned for development. Follows planned greenways and parks. Provides connectivity between the ALR and Tynehead Park. Naturalize edges of planned greenways. Traffic calming and signage at 96 Ave.
121	Low	Moderate	Local	50	Hydro right of way. This area is mostly field habitat in the yards of residential neighbourhoods. It provides a continuous corridor throughout a landscape that is planned for infill development. Work with adjacent landowners to naturalize this area and remove barriers to movement. Create wetlands in lowland areas. Traffic calming and signage for road crossings. Improve wildlife passage at Highway 15
122	Moderate	Moderate	Regional	60	Riparian area for Leoran Brk. Fragmented patches of forest habitat. Includes one park. Provides one of few passages under Highway 1 and connectivity to Surrey Bend Park. Ensure passage under the South Fraser Perimeter road. Enhance ditch adjacent to this road. Protect land adjacent to riparian setback. Work with adjacent landowners to naturalize adjacent private land and remove barriers to movement. Traffic calming and signage at 179 St. Provide passage under the South Fraser Perimeter Road.
123	High	Moderate	Regional	50	Fragmented forest habitat through low density residential neighbourhood. Area is planned for development. Follows planned greenways and parks. Provides connectivity between proposed Hub A and the ALR north to underpass of Highway 1 and the riparian corridor of Leoran Brk. Naturalize edges of planned greenways. Traffic calming and signage at 180 St. Provide a movement corridor under Golden Ears Way.
124	high	High	Regional	50	Foreshore riparian area to Fraser River. Highly impacted by industrial development. Explore opportunities to restore this riparian area.
125	Moderate	High	Regional	50	Edge buffer to ALR. Large forested natural area. Runs through proposed Hub A. Established and protect a forested corridor.

ID	RISK OF DEVELOPMENT	ECOLOGICAL VALUE	CORRIDOR TYPE	TARGET WIDTH (M)	RECOMMENDATIONS
126	Moderate	Moderate	Local	60	Riparian area of upper Serpentine River. All dyked and highly disturbed for agriculture. Protect land adjacent to riparian setback. Naturalize this area by planting native tree and shrub cover. Improve wildlife passage at Highway 15. Traffic calming and signage at 82 Ave.
127	High	High	Regional	50	Large forested natural area. Runs through proposed Hub A. This forested area provides connectivity between Serpentine river and Tynehead Park. Establish and protect a forested corridor. Traffic calming and signage at 88 Ave.
128	Moderate	Moderate	Regional	50	Edge buffer to ALR and partial riparian corridor. Includes fragmented natural areas. Provides important edge habitat to ALR field habitat. Provides connectivity between proposed Hub A and Latimer Creek. Established and protect a forested corridor on perimeter of the ALR. Enhance disturbed riparian habitat. Traffic calming and signage along 88 Ave and at 184 St.
129	Moderate	Moderate	Local	30	Fragmented natural and riparian habitat through an area that is planned for development. Follows planned greenways and sediment ponds. Provides limited connectivity through developed neighbourhood. Traffic calming and signage at 92nd Ave and 187 St.
130	Moderate	Moderate	Local	60	Riparian area of lower dyked portion of Latimer Cr. Highly disturbed for agriculture. Protect land adjacent to riparian setback. Naturalize this area by planting native tree and shrub cover. Improve wildlife passage at Harvie Rd.
131	Moderate	Moderate	Local	60	Riparian area of creek. Protect and enhance land adjacent to riparian setback. Traffic calming and signage at 188 Ave.
132	Moderate	High	Regional	60	Riparian area of Latimer Cr. Mostly forested. Protect and enhance land adjacent to riparian setback. Traffic calming and signage at 192 St and 188 St.
133	Moderate	High	Local	60	Riparian area of south arm of Latimer Creek. Mostly forested except west section which is heavily impacted by agriculture. Protect land adjacent to riparian setback. Naturalize disturbed areas by planting native tree and shrub cover. Traffic calming and signage at 188 St.
134	Moderate	Moderate	Local	50	Edge buffer for ALR. Includes fragmented natural areas. Provides important edge habitat to ALR field habitat. Establish and protect a forested corridor on perimeter of the ALR. Traffic calming and signage at 192 St.
135	High	Moderate	Local	60	Riparian corridor for creek. North end runs along border with Langley. Non forested areas are impacted by residential development. Protect and enhance land adjacent to riparian setback. Traffic calming and signage at 80 Ave.
136	High	Moderate	Local	60	Riparian corridor for creek. Runs through a large intact forested habitat areas that is proposed as Hub C. Non forested areas are impacted by residential development. Protect and enhance land adjacent to riparian setback. Traffic calming and signage at 192 St and 80 Ave.
137	High	Low	Local	30	This corridor is highly impacted by residential development. Follows planned greenways. Provides limited connectivity through developed neighbourhood. Naturalize edges of planned greenway. Traffic calming and signage at road crossings. Traffic calming and signage at 192 St.
138	High	Moderate	Local	50	Riparian corridor for creek. Runs through a large intact forested habitat areas that is proposed as Hub C. Non forested areas are impacted by residential development. Protect and enhance land adjacent to riparian setback. Traffic calming and signage at 76 Ave and 80 Ave.
139	High	Moderate	Local	60	Fragmented natural forested areas running through low density residential neighborhood. Greenway has been established through re-development. Provides connectivity between Hub C and the ALR. Enhances connectivity of corridors 90 and 88. This area supports habitat for Species at Risk. Traffic calming and signage for crossings at 184 and 188 Streets. Ensure a safe, naturalized interface with 78 Ave which is planned to be developed within or adjacent to this greenway.
140	Moderate	Moderate	Local	50	Edge buffer for ALR. Includes fragmented natural areas. Provides important edge habitat to ALR field habitat. Established and protect a forested corridor on perimeter of the ALR. Traffic calming and signage at 80 Ave, 184 St and 188 St. Provide a movement corridor under Highway 10.
141	High	Low	Local	60	This corridor includes a mix of riparian, forested natural areas and low density residential development. Follows planned greenways. Provides limited connectivity through developed neighborhood. Naturalize edges of planned greenway. Traffic calming and signage at 72 Ave, 76 Ave. Provide a movement corridor under Fraser Highway.
142	Low	High	Local	80	Riparian area for creek with well established setbacks. High density development up to riparian setbacks. Restrict access and enhance habitat. Provide a movement corridor under Fraser Highway.
143	Low	Low	Local	50	Hydro right of way. This right of way includes a range of habitat features. It provides the only continuous corridor throughout this highly developed landscape. Establish hedgerows and shrub pockets. Create wetlands in lowland areas. Traffic calming and signage at 64 Ave, 60 Ave, 184 St and 188 St. Provide a movement corridor under Highway 10.
144	Moderate	Low	Local	60	Riparian corridor for creek. Portion in the ALR runs through a forested area. North portion high impacted by urban development. Provides connectivity between the Nicomekl River and the BC Hydro right of way. Protect land adjacent to riparian setback. Naturalize disturbed areas by planting native tree and shrub cover. Provide a movement corridor under Highway 10.

Table 33 Inventory of corridors

LABEL	RISK OF DEVELOPMENT	ECOLOGICAL VALUE	HUB OR SITE	RECOMMENDATIONS
Blackie Spit	Low	Moderate	Hub	Provides high value intertidal wetland communities. Has low tree cover and highly accessible. Designate a wildlife refuge area with restricted access. Increase tree cover in upland sites. Establish hedgerows along shoreline areas that are highly used for recreation.
Crescent Park	Low	High	Hub	Includes large areas of intact mature forest. Includes red listed plant communities. Root rot has created pockets of high value wildlife trees. Designate and protect a wildlife refuge area. Create additional wetland habitat in open fields adjacent to forests.
Sunnyside Acres Urban Forest	Low	High	Hub	Includes large areas of intact mature forest and an arboretum. Designate and protect a wildlife refuge area along the south end of this park. Create additional wetland habitat in open fields adjacent to forests.
Redwood Park	Low	High	Hub	Protected park. Includes large areas of intact mature forest. Designate and protect a wildlife refuge area. Create additional wetland habitat in open fields adjacent to forests.
Latimer Lake Park	Low	High	Hub	Large intact forested area. Includes Latimer creek. Provides valuable forest habitat within an area being developed for industry. Designate a wildlife refuge area in a part of this park.
Mound Farm Park	Low	Moderate	Hub	This park includes a patch of forest with high ecological value and includes trees of significant size. Most of the property is leased for agriculture. This is one of the few protected areas within the ALR. Restore a native forest community in the areas currently used for agriculture.
Elgin Heritage Park	Low	High	Hub	Provides high value intertidal wetland communities. Has low tree cover and highly accessible. Designate a wildlife refuge area with restricted access. Establish hedgerows along shoreline areas that are highly used for recreation.
Serpentine Fen	Low	High	Hub	This is a large protected wetland that provides high value habitat and refuge for birds.
Port Kells Park	Low	High	Hub	This is a large protected natural area that includes Latimer Creek and its tributaries. Designate and protect a wildlife refuge area.
Surrey Lake	Low	High	Hub	This is a large protected natural area that includes Surrey lake and associated wetland communities. Designate a wildlife refuge area in a part of this park.
Tynehead Regional Park	Low	High	Hub	Includes large areas of intact mature forest. Includes habitat for species at risk. Designate and protect a wildlife refuge area. Consider fencing along Highway 1.
Surrey Bend Regional Park	Low	High	Hub	Large intact natural areas that support rare habitat types including bogs and wetlands. Designate a wildlife refuge area with restricted access. Consider fencing along South Fraser Perimeter Road to direct wildlife to underpass.
Fleetwood Park	Low	High	Hub	This is a large protected forested natural area that borders the ALR. Includes Fleetwood creek and tributaries. Designate a wildlife refuge area in a part of this park.
Invergarry Park	Low	High	Hub	This is a large protected forested natural area. It includes Bonaccord creek and its tributaries. Provides valuable connection though the north part of Surrey. Designate a wildlife refuge area in a part of this park.
Hawthorne Park	Low	High	Hub	This is a large protected forested natural area that is relatively flat. Includes lakes and Bon Accord Creek. Create wetland habitat in open fields. Designate a wildlife refuge area in a part of this park.
Green Timbers Urban Forest	Low	High	Hub	This is a large protected forested natural area that includes a lake, field habitat and a number of creeks. Consider fencing along Fraser Highway to protect the wildlife refuge area in the southeast corner of the park.
Bear Creek Park	Low	High	Hub	This is a large protected forested natural area. Includes A number of high value creeks. Create wetland habitat in open fields. Designate a wildlife refuge area in a part of this park.
Colebrook Park	Low	High	Hub	This is a large protected forested natural area that borders the ALR. Includes high value forested swamp. Designate a wildlife refuge area in a part of this park.
Proposed Hub A	High	High	Hub	This is a large natural forested community. It is the largest unprotected forested community in this area that is not planned for development. It provides an important connection between Serpentine river and Tynehead Park. Forest community provides valuable edge habitat to adjacent agriculture communities.
Proposed Hub B	High	Moderate	Hub	Large intact forested area along the Langley border connecting to Hi-Knoll Park. Includes a small lake and Anderson Creek. This area provides a large wildlife refuge in an area that is highly developed.

LABEL	RISK OF DEVELOPMENT	ECOLOGICAL VALUE	HUB OR SITE	RECOMMENDATIONS
Proposed Hub C	High	High	Hub	Large natural forest partially protected as park. Largest unprotected forest community in this area, which is becoming highly developed and fragmented. Provides valuable wildlife refuge.
Proposed Hub D	High	High	Hub	Largest unprotected natural forest community in an area highly impacted by agriculture and urban development. Only natural forest area of significant size next to the Serpentine River corridor. Adjacent lowland wetlands should be included in this Hub, if possible.
Proposed Hub E	High	Moderate	Hub	Large natural forest area with numerous creeks. Provides connectivity to natural areas of Washington.
Proposed Hub F	High	High	Hub	Large natural area with important aquatic and riparian habitat for species at risk. Pockets of forest and shrub communities fragmented by old fields. Protected areas, including Fergus Park, are located in this proposed Hub. Protect additional land through acquisition to create larger contiguous natural area. Restore forest communities along creeks. Create wetlands in old fields adjacent to forests.
Proposed Hub G	Moderate	High	Hub	Large, intact forested area including some protected parkland in the northeast (Glade Park). Includes young mixed and deciduous forest located mostly in ALR. This area has steep slopes with numerous creeks making development for agriculture difficult. This habitat provides an area of refuge between the Campbell Heights industrial area and the developed areas of the ALR. This forest provides important north south connectivity through the ALR.
Proposed Hub H	High	High	Hub	Large intact forested area. Includes mature forest with trees of significant size. Protect this area as a park through acquisition.
Proposed Hub I	Moderate	High	Hub	Large intact forested area with important aquatic and riparian habitat. It includes two reaches of the Little Campbell River. A large portion of this natural area is owned by the City. Protect this area as a park through acquisition. Create wetlands in old fields adjacent to forests.
Proposed Hub J	High	High	Hub	Forested patch adjacent to the lower reach of the Nicomekl River. Provides last remaining and critical movement corridor between the ALR to the east and natural areas in Sunnyside MU.
Proposed Hub K	Moderate	High	Hub	Fragmented patch of forest adjacent to the lower reaches of the Little Campbell River. It provides valuable forested riparian community for this river. The recommended corridor should be expanded in this area to protect as much of this natural forest as possible.
Proposed Site L	Moderate	High	Site	Mixed forested patch and a pond located next to the Little Campbell River and its floodplain wetlands. Surrounded by agricultural land. Provides a high value mix of habitat types.
Proposed Site M	Moderate	Moderate	Site	Fragmented forests and shrub communities. Includes a patch of conifers. Much of this area has been disturbed. The value in this area is its location and restoration potential. It is located along the Serpentine corridor and connects with a network of protected natural areas.
Proposed Site N	Moderate	High	Site	Mixed forest located adjacent to Port Kells Park. Includes Latimer Creek and its tributaries. Only portions could be developed outside of riparian setbacks. Together with the park provides a large valuable forested area with aquatic and riparian habitat.
Proposed Hub O	Moderate	High	Hub	Intact patch of mixed and deciduous forest with a large pond and wetland complex. Connects three reaches of the Little Campbell River and associated GIN corridors. Provides a large valuable forested area with wetland, aquatic and riparian habitat.

Table 34. Inventory of existing hubs and high priority hubs and sites

