

Natural Areas: Vegetation Management Strategy

Greg Ward

Manager, Park Urban Forestry and Environmental Services

Shawn Gurney

Technician, Park Urban Forestry and Environmental Services

Edited by: Diana Wegner

Professional Writer

Table of Contents

<i>Introduction</i>	3
The City’s Mandate to Preserve and Protect Natural Areas	3
Ecological and Social Benefits	3
Purpose and Scope	4
History.....	4
Current Conditions and Initiatives	5
Ecosystem Degradation	5
Counter-productive Management Practices	6
Positive Initiatives in Natural Areas	7
<i>Vegetation Management Strategy</i>	8
Principles.....	8
Goals and Objectives	8
<i>Recommendations</i>	10
Immediate Recommendations 1–3 years	10
Inventory Data Base.....	10
Annual Maintenance Management Program	10
Protection	14
Integration.....	14
Mid-term Recommendations 2–4 years	15
Resources	15
Species Protection.....	16
Education and Awareness	16
Degraded Land Assessment	17
Long-term Recommendations 3-5 years, or as resources allow.....	17
Site-Specific Plans and Programs	17
Provision Standards	18
Natural Area Fragmentation	18
<i>Appendix A:</i>	20
Rare and Endangered Natural Plant Communities	20
<i>Appendix B:</i>	24
Rare and Endangered Plant Species.....	24
<i>Appendix C:</i>	27
Invasive Species List.....	27
Invasive Species Found in Surrey.....	28
Individual Account of Shrub and Herbaceous Species.....	28
<i>References</i>	48

Introduction

The City's Mandate to Preserve and Protect Natural Areas

Surrey is a diverse region of a wide variety of natural habitats. These natural areas provide feeding and nesting grounds for wildlife, as well as wintering areas for migrating waterfowl. As one of Canada's faster growing cities, Surrey's large natural areas have been significantly altered or developed to make way for human settlement. The loss of natural areas within the region has seriously reduced the numbers of native plants, animals, fish and bird species, to the degree that some are now designated threatened or endangered, while others have been completely eliminated from the region.

Surrey has been progressive in setting aside considerable tracts of natural areas as parks, such as Blackie Spit, Sunnyside and Green Timbers Urban Forests, and acres of forested areas adjacent to salmon bearing streams. The impetus for these protective measures has come from both the City and concerned members of the community. For example, Surrey residents have identified open spaces and stewardship of the natural environment as a significant concern through the Future Surrey Vision process. As a result, Surrey's *Official Community Plan (OCP)* acknowledges the importance of open natural spaces in a community—both for recreational purposes and for wildlife habitat—and recognizes the need to preserve and protect the natural environment. These values are also reflected in the 1996 *Parks and Recreation Master Plan (PRMP)*, and the Parks, Recreation and Culture Department incorporates the protection of the natural environment into its mission statement.

The OCP has set guidelines for provision of parklands and open spaces, which are reflected in five park categories, one of which is, "Nature Preservation and Linkage." This category refers to land that is set aside for either, conservation and preservation purposes, or to assist in providing a network of green linkages throughout the City. Natural areas are broadly defined as lands that are composed primarily of native vegetation, have significant habitat value and are being managed as community natural resources.

Although approximately 60% of City parkland is in its natural state, the management of these natural areas has been ad hoc and without appropriate overall direction. Properly managing the vegetation is a key to successful overall management of natural areas. The vegetation is the "engine" from which all other natural area resources and values derive their meaning.

Ecological and Social Benefits

Native plant communities have the greatest influence on wildlife habitat, and ultimately determine the types of other organisms that will be attracted to natural areas. As primary producers, plants are fundamental to most other life forms. They are the foundation of our complex food webs and have the greatest effect on the provision for biodiversity, locally and globally. In urban settings particularly, natural area vegetation is by far the most critical vegetation component for mitigating climate change and the negative influences of urbanization. The following lists highlight some of the many benefits of natural area vegetation:

Environmental Benefits

- Ecological integrity
- Food and shelter for wildlife
- Addition of oxygen to the atmosphere
- Carbon storing
- Erosion control
- Moderation of ground temperatures
- Moderation of groundwater flows and flood control

Human Benefits

- Ecological integrity
- Aesthetics and beauty
- Noise reduction and pollution control
- Economic benefit through enhanced property values
- Provision for high demand recreational activities such as walking and biking
- Social interaction

Purpose and Scope

The purpose of this Strategy is to provide overall direction to the Parks Division in the management of natural area vegetation. The Strategy must balance the duality of providing for recreation in natural areas with protecting the vegetation resource.

This management plan provides background and strategic direction as follows:

- A history and assessment of current conditions and initiatives
- Vegetation management principles
- High level goals and objectives
- Specific and prioritized recommendations with implementation timelines for measures necessary to achieve these objectives
- A comprehensive outline of a vegetation management program, with procedures and guidelines that enable the Parks Division to protect, preserve and enhance the vegetation resource.

History

Although Surrey has been described as untouched wilderness prior to European settlement, aboriginal peoples were already actively managing their environment. They often used selective logging and controlled burning in order to maintain open meadow areas. These

open areas were used to provide suitable growing conditions for desirable food plants and forage crops that would attract deer and animals used for food.

Prior to the arrival of non-aboriginal settlers, Surrey was dominated by temperate rainforests interspersed with areas of grasslands, wetlands and shorelines. Non-forested areas generally occurred in places that were too wet or too saline for trees to survive or in areas where disturbances such as fire, wind or disease killed groups of trees, creating open meadows.

Since the arrival of Europeans and other non-aboriginal groups, more extreme and often drastic changes to the environment have occurred over a relatively short period. Forests have been eliminated, and wetlands have been drained and dyked for settlement and agriculture. This fragmentation and loss of wildlife habitat have resulted in a serious significant loss of biodiversity. Many species are now endangered or threatened and some have already been eliminated (see Appendix A and B for a list). To compound this degradation, foreign plant and animals species have been introduced into these areas, further displacing native animals and vegetation.

Foreign plant species have had a significant impact on native plants and animals, for they are often resilient and aggressive. For example, Scotch broom, English ivy, purple loosestrife and European blackberries have successfully out-competed and displaced native plants in many areas. This elimination of native plant species has resulted in loss of traditional sources of food and shelter for wildlife.

As the City has urbanized, the last vestiges of the wilderness are found primarily in the parkland that the City provides. Amongst the many residential subdivisions, commercial core areas and industrial parks, natural areas are sometimes being preserved as “nature preservation and linkage parks.” Although approximately 60% of existing parkland is currently in a natural state, the native vegetation is under considerable urban pressure.

Current Conditions and Initiatives

Natural areas are scattered throughout Surrey in regional parks, City parks, agricultural lands and special wildlife management areas such as the Serpentine Fen adjacent to Boundary Bay. Pockets of natural areas also exist in BC Hydro and BC Gas right-of-ways and other privately held properties. The current situation of vegetation management involves both an acknowledgement and diagnosis of both the impediments to vegetation health and the current efforts to redress these problems.

Ecosystem Degradation

Within the City of Surrey natural areas are under enormous pressure due to urbanization and attendant land clearing. Many are in decline because of damage to local hydrology, overuse by humans, and misuse through dumping of wastes. Streets, roads, subdivisions, even cultured areas of parks all contribute to changes that tend to fragment the vegetation resource, often reducing complete ecosystems to small parts of the whole.

The natural area vegetation in the City of Surrey is subject to the following impacts and stresses.

- Deforestation and fragmentation
- Recreation and general usage
- Public attitude toward the ‘untidiness’ of natural areas

- Trail clearing and construction activities (sanctioned and unsanctioned)
- Land development and drainage alterations
- Vandalism and dumping of refuse and yard waste
- Excessive, indiscriminate mowing, pruning or thinning practices

- Exposure to pollutants
- Competition with exotic plant species
- Destructive arthropod and pathogen invasions
- Soil compaction and topsoil erosion

Counter-productive Management Practices

Parkland management programs have traditionally entailed the application of techniques and practices founded in the science of horticulture. The essence of these techniques and practices is the control, manipulation and change of the landscape. Management of natural area vegetation has been compromised by the application of these practices to a vegetation resource that is better managed through an eco-sensitive approach that considers the requirements of native vegetation and the wildlife habitat with due consideration to the needs of people.

For instance, many natural areas have been planted with ornamental tree cultivars, as “improvements” to the native plant communities. The management practice of mechanized mowing of the natural area edges, although efficient and cost effective, is a practice that often provides opportunity for establishment of invasive species.

Management of the natural areas has also been compromised by the absence of an attribute based inventory, non-ecosystem-sensitive management objectives, and non-adaptive planning. For example, although the Parks Division has many of their individual assets digitally stored in a shared database, there is currently no database for any of the many natural area resource attributes. This lack of natural area inventory contributes to non-ecosystem sensitive management practices and hinders adaptive planning processes due to a lack of access to information by land managers and planners.

At present, there are very few scheduled maintenance activities conducted in natural area parks. Specific and comprehensive service level standards have yet to be articulated. The lack of a comprehensive maintenance management program has resulted in the gradual progression in some areas from grasslands to forest.

Positive Initiatives in Natural Areas

Greenways Plan: This plan is a city-wide network of off-street pedestrian and bicycle connections. The objective of this project is to transport people in an environmentally friendly way. The Greenways network connects parks, natural ravines and utility right-of-ways in order to provide transportation corridors. It also provides a number of passive recreational opportunities.

This project parallels and supports both the BC Ministry of Environment Greenways Project and the GVRD Green Zone Strategy, which promote biodiversity through the development of a system of green corridors that reduce habitat fragmentation by linking natural spaces.

Official Community Plan (OCP): The OCP was adopted as By-law No. 12900 by Surrey Council in 1996 in order to guide land use and development over a period of five to six years. The OCP recognizes the need to protect natural areas and commits to protecting and enhancing the natural environment by establishing parks, open spaces, protected habitats and conservation areas.

The OCP also recognizes the importance of agriculture to the economy and encourages the protection and enhancement of agricultural area. It supports the Agricultural Land Reserve and encourages wildlife management and habitat protection practices that minimize impact on agricultural lands without jeopardizing habitat and wildlife resources.

Releaf Program: Under the supervision of the Surrey Parks' staff, volunteer groups plant trees and shrubs in riparian zones, detention ponds, forests and other parks throughout the City. This program not only enhances the environment, but also encourages stewardship by providing opportunities for public involvement.

Hi-Knoll Park Pilot Project: A joint project has been undertaken between BC Hydro and Surrey Parks to develop a vegetation management plan that will maintain the area as wildland habitat, with a variety of vegetation types throughout the site. This initiative is representative of a growing trend in park management that considers, first and foremost, the ecology of the site and values of the natural resources that require protection and preservation.

Vegetation Management Strategy

The City of Surrey recognizes the vital importance of its natural areas and has been actively acquiring many hectares of parkland in an effort to protect its most significant and sensitive natural areas. The Vegetation Management Strategy will assist decision makers in future acquisition initiatives and provide sound direction in the planning, developing and managing of park natural areas. Vegetation management in natural areas must be carefully managed in urban areas through a wide set of scheduled maintenance activities to ensure optimum benefits to the environment, and the community.

Principles

The following principles provide direction for setting management goals and objectives, resolving issues, developing a vegetation management program, assisting Parks Division resource allocation discussions, and developing Parks Division annual work plans for natural areas.

The informing principles are that vegetation in natural areas:

- Constitutes a valuable global, regional, and community resource, and is critical to wildlife habitat
- Essential to sustainability and biodiversity
- Contributes significantly to park experiences
- Contributes significantly to the cultural and heritage values of the City



Goals and Objectives

The overall goal is to protect, preserve and enhance the resource, providing both wildlife habitat and recreational opportunities. The following goals and objectives are derived from the principles above, and are designed to give the necessary support and direction to develop a comprehensive vegetation management program.

1. Adopt of a sustainable approach to managing natural area vegetation.

Vegetation management for sustainability requires managing to provide for ecological, economic and social benefits over time. This entails implementing strategies that meet the needs of the present without compromising the needs of the future. It means practicing a land stewardship ethic, which integrates the growing and nurturing of vegetation, with strategies for the conservation of soil, air and water quality, and wildlife and fish habitat. Sustainable vegetation management considers vegetation biodiversity on a local, regional and global level. Two of the goals in this area are:

- To create a structurally diverse ecosystem with a mix of ages, species and sizes of plants that embodies a healthy vegetation resource.

- To acquire natural area lands in a variety of shapes and sizes—the goal being, to reduce the effects of localized urbanization on the vegetation resource.

2. Preserve, protect and enhance the native vegetation in natural areas.

The preservation theme denotes the need to set aside natural areas in perpetuity for the enjoyment and benefit of all generations, and to manage these areas with the intention of preserving the vegetation resource. This does not preclude the need sometimes to develop natural areas for a variety of uses, but asserts the importance of managing the vegetation as a resource intended primarily for non-consumptive and compatible uses.

- Preservation also requires policy resolutions that support the preservation of the vegetation resource despite the sometimes-powerful arguments to remove the vegetation due to nuisances such as insects, leaf drop or “cottonwood tree fluff.”
- The protection theme denotes the need to recognize that natural area vegetation is often subject to significant urban pressures to alter, change or sometimes destroy the resource. The pressure can be intentional, but is often unintentional, resulting from a lack of understanding of the requirements of the vegetation resource.
- The enhancement theme addresses the fact that urban natural areas will not succeed naturally through their seral stages as they do in non-urban areas. Human intervention is required to ensure the health of the resource.

3. Integrate vegetation management plans with other resource management plans and initiatives.

Any vegetation management work plans must be integrated with other natural area management plans and initiatives. Urban natural areas are valued not only for their vegetation but for their considerable recreational values, usually passive but sometimes active. The provision of recreation in natural areas is often competitive with the development of a healthy vegetation resource. Vegetation is often destroyed by overuse by people. A reasonable balance needs to be achieved by considering these often contrary values concurrently in any management plans for a natural area.

4. Active intervention and management

Natural areas located outside urban areas tend to develop naturally and healthily without much human intervention, but in urban natural areas human intervention and management are required. For instance, encouraging successional development of natural areas in urban environments may be necessary due to lack of seed source or natural distribution of seeds. Active intervention is also necessary because humans sometimes cause the introduction and establishment of unwanted alien invasive plant species into natural areas. Planting programs are one of the many necessary intervention activities required to ensure healthy natural areas.

A comprehensive management program should be developed for natural areas and should set priorities for all necessary operations and maintenance of natural areas.

Recommendations

The following recommendations will serve as a guide for the Parks Division to manage natural area vegetation for the next five years. The initiatives are listed in order of implementation priority—Immediate, Mid-term, and Long-term recommendations. The prioritization of these initiatives is based on the current level of funding, the best return for funding invested, the City’s risk and liability exposure, and the degree of critical need.

Immediate Recommendations 1–3 years

The immediate recommendations fall under four main categories—Inventory Data Base, Annual Maintenance Management Program, Protection and Integration. Each category contains more specific information on these prioritized initiatives.

Inventory Data Base

Currently, the Parks Division does not have an inventory database of natural areas, and although some scheduled maintenance does occur, such as mowing of natural area grassland, there has been little, or no work tracking history, monitoring resource condition, prioritizing site maintenance activities, and developing site-specific management plans.

- Implement a data collection project as the first priority. The minimum this initial data collection should include would be, assessing natural areas for their location, size, shape, general vegetation cover type, drainage patterns, and general site health, and should be collected in a tabular and spatial format.
- Annually update and audit the accuracy of the natural area database to enable comprehensive management of the vegetation.
- Use the spatial and tabular database to ensure service level standards are consistent across the City.
- Develop an in-house classification system for natural areas. At the time of writing this Strategy, the Parks Division is conducting an inventory of forest natural areas based primarily on broad vegetation classes.

Annual Maintenance Management Program

The following activities should be included in annual work plans that are developed for managing natural areas. These activities encourage a sustainable, healthy vegetation resource, provide for biodiversity and ecosystem integrity, plan for appropriate age class distribution throughout natural areas and ensure a safe and meaningful experience for park patrons.

Update Tabular and Spatial Inventory Data Base

It is necessary to continually review the tabular and spatial database to ensure its integrity and accuracy. Inventories should be a part of annual work plans, with the goal of visiting all natural areas in Surrey's parkland inventory within a five-year period.

- The Parks Division should attempt to review and assess each natural area within five years to update the inventory database.
- Additionally, the collection of critical site-specific resource data needs to be added as the general inventory is completed.
- Because the Parks Division is not regularly notified of additional natural area lands under their management, the Division should also systematically review each map grid area within the City on a five-year rotation.

Monitor Vegetation Condition

Over time, natural areas are susceptible to gradual changes that have drastic effects to their overall health.

- Monitoring to assess the condition and any changes in the vegetation resource should occur in each natural area on a five-year rotation.
- Develop a condition attribute rating scale that could include measuring for growth and mortality rates, and developing average site index curves for modeling purposes.

Regenerate and Restore Vegetation

Although natural areas have a great capacity to regenerate, this capacity is severely compromised in urban areas. Native plant seed-dispersion is often limited by lack of seed source or seed carriers (wildlife). As well, invasive non-native plants often establish themselves before native plants do.

In the past, little or no funding resources have been applied to natural areas where restoration of the native vegetation is required. A backlog of renovation projects for natural areas and degraded parks requires a considerable infusion of renovation funding.

- Restoration activities should be based on priority needs, recognizing that environmentally significant areas, such as riparian areas, must be attended to first.
- Restoration activities include investing considerable resources in the planting of ecosystem appropriate native plants and trees.
- The re-introduction of extirpated plant species, and the planting and care of threatened or endangered plant species should be a high priority.
- Significant efforts in ongoing vegetation maintenance activities, such as watering and clearance of brush to establish recently planted areas, are necessary to ensure healthy growth.

- The Parks Division could also consider adopting an operating procedure that seeks to replant a tree in established natural areas, when appropriate, for every hazard tree that is removed.

Conduct Vegetation Hazard Management Activities

This activity is primarily related to the inspection and assessment of trees due to whole, or part tree failure. It includes responding to requests for service to assess and abate hazard trees, and to conduct scheduled tree hazard inspections. (Please refer to the *Tree Hazard Management Strategy* for specific details.)

Control and Manage Invasive Species

Certain species of non-native plants can be beneficial when they are maintained at endemic levels. They offer inherent socioeconomic and ecological benefits, such as provision of food and shelter for wildlife, soil stabilization in disturbed areas and botanical products for human consumption. If left unchecked, however, they can become a destructive force when their populations become epidemic, which many do at an alarming rate. These plant species consist of:

- Non-native or exotic plant species—those that were not present in natural areas prior to the arrival of European settlers.
- Invasive plant species—those that have the capability to invade and overtake native plant communities or natural area landscapes.

In Surrey, the most noticeable effects of invasive, non-native vegetation are the suppression of native plant species and their associated organisms, and the resulting reductions in local species abundance and diversity. Reduced aesthetic values are also a concern in some areas. In some cases the natural area landscape may be predominated by non-native species and severely reduced in wildlife habitats.

To limit the negative effects of the uncontrolled spread of invasive, non-native plant species, it is recommended that prevention and suppression be an integral aspect of managing vegetation resources. The following measures should be adopted to meet this goal.

- **Prevention:** public and in-house education, early detection and containment and reduction, or restriction of potentially available sites. Prevention methods include the following:
 - A complete list of invasive, non-native plants in Surrey should be compiled, including full colour photographs and descriptions for identification and recommended control methods (see Appendix C: Invasive Species List).
 - Any discoveries of these listed non-native plant species should be surveyed and reported.
 - Staff should be informed that dumping of non-native plant materials must be restricted to pre-designated dump sites where maximum containment can be achieved.
 - Appropriate literature pertaining to this topic should be distributed to residents near problem areas.

- **Suppression:** physical removal or destruction of offending plants, and re-introduction of competitive native species. When determining if a control program is necessary the following questions must be addressed.
 - Does the invasive plant provide wildlife habitat?
 - What negative impacts will be associated with plant removal?
 - Do the negative aspects outweigh the advantages?

Control programs can include:

- Physical removal
- Chemical herbicides
- Biological controls
- Prescribed burning

Undertake Vegetation Control Activities

- Scheduled pruning and sensitive mowing of natural area vegetation is necessary, especially where natural vegetation encroaches onto roads and sidewalks.
- It may also be necessary to periodically mow or burn grasslands to sustain the ecosystem.

Control or Eradicate Pests

Pest populations can reach levels in natural areas where it is necessary to invoke measures to control or eradicate the pest to ensure the viability of the vegetation resource. Vegetation condition monitoring activities, such as those recommended above would provide information on current conditions and therefore help staff decide whether pest management is necessary (also see *Fauna Management Strategy*).

At this time, the Parks Division does not have an integrated pest management plan. An overall vegetation management program should adopt a systematic approach to pests that uses a variety of techniques to reduce pest damage to tolerable levels.

When pest population could result in significant damage to the vegetation resource, the Parks Division should utilize the following general pest management techniques.

1. Natural predators and parasites
2. Genetically resistant hosts
3. Environmental modifications
4. Pesticides (when necessary and appropriate)

Soil management

A healthy vegetation resource, contributes directly to the health of the natural area soil. Although soil management in natural areas can take on a variety of dimensions, it is recommended that initial activities be conducted in the areas of hydrology, coarse woody debris enhancement and soil compaction management.

- Hydrology management includes assessing sites for their drainage requirements and undertaking measures to modify the hydrology if necessary. This could include directing more water to the site, or undertaking works to drain water from the site.
- Coarse woody debris in many of Surrey's natural areas has been removed resulting in structurally and nutritionally deficient soils (see the *Coarse Woody Debris Management Strategy* for specific recommendations).
- Soil compaction management recognizes the need for soil regimes that provide unimpeded root growth by avoiding soil compaction and taking steps to alleviate soil compaction when appropriate. Avoidance would include undertaking trail closures, and alleviation would include adding organics to the soil.

Protection

Actively undertake other protection measures, and they are as follows.

- Develop and implement standards, specifications and regulations for land developers that will protect natural area vegetation during development and construction activities.
- Monitor development sites adjacent to natural areas to ensure development activities do not damage the vegetation.
- Apply and enforce by-laws, policies and regulations when appropriate.
- Implement a “zero tolerance” for the encroachment of private property onto natural areas and immediately direct the owner to move the encroachment.
- Routinely install fencing and other devices, and close trails to re-route traffic within, and adjacent to, natural areas.
- Use adaptive park planning processes that identify the long-term consequences of siting pathways and recreational amenities near natural area vegetation. For example,
 - The siting of playgrounds adjacent to native urban forests requires the removal of understory plants to comply with the Parks, Recreation and Culture Security for Parks Patrons Policy.
 - The siting of recreation amenities beneath cottonwood trees creates an unmanageable hazard due to their sudden, summer branch drop.

Integration

Currently, only park native forests are managed by the Parks Division's Urban Forestry and Environmental Services Section. But the management requirements for all natural area vegetation communities, such as forests, grasslands, shrublands, is very similar, and the ecosystems are strongly interrelated, and interdependent.

- Following the development of an inventory database of natural areas, the Parks Division should consolidate the management of all natural areas within the Urban

Forestry and Environmental Services Section of the Parks Division. This consolidation would ensure more effective and efficient management of all natural area ecosystems through application of consistent management regimes by staff knowledgeable in natural resource management. As well, consolidation will enhance the delivery of the wide array of natural area environmental education initiatives that are possible yet unexplored.

- The Parks Division should then consider the renaming the Urban Forestry and Environmental Services Section to perhaps the Urban Forestry and Natural Area Management Section as the current descriptor, ‘Urban Forestry’, would not adequately encompass and adequately describe the broad range of land types under their management.

Mid-term Recommendations 2–4 years

The mid-term recommendations for a comprehensive vegetation management strategy fall under four main categories—Resources, Species Protection, Assessment and Education and Awareness. Each category contains more specific information on these prioritized initiatives.

Resources

The development and pursuit of a wide variety of resources for implementing the vegetation plan is necessary to ensure its success. To that end, these are the recommendations to increase resources both human and monetary.

Volunteer Participation

At present, despite a considerable volunteer component in the parks service delivery, the amount of volunteer activity associated with the comparatively high amount of natural area parkland is relatively small.

- Increase volunteer participation in some vegetation management activities. High public concern for the state of the natural environment means there is a “captive market” for enlisting volunteers. The range of activities and required personnel skills is such that a volunteer initiative would likely attract a large number of candidates (e.g. for physical work such as manual invasive species removal, or for site monitoring to reduce illegal dumping of refuse, etc.).

Partnerships

There are a variety of agencies and non-government organizations involved in stewardship of the environment and the City would benefit from the development of strong relationships with these essential groups.

- Explore potential partnerships. This could include other City departments such as Engineering, senior levels of government including the Greater Vancouver Regional District, and the various provincial ministries involved in the stewardship of the natural environment.

- Develop relationships with the host of local community organizations, such as the White Rock Surrey Naturalists, and non-governmental organizations such as the Evergreen Foundation. These groups and others like them are committed to natural environment stewardship
- Apply to the many private and public agencies, trusts and stewardship groups for grant funding to support natural area initiatives.

Costs

- Develop unit costs, based on accepted service level standards, for vegetation management activities.
- Conduct satisfaction surveys, monitor natural area health over time. By doing this, the Parks Division would develop reliable data to assist decision makers in determining annual base funding necessary for the maintenance, operation and development of natural areas.

Species Protection

With the abundance of natural areas within its park system, Surrey has a unique opportunity to make a difference and establish a regional model for species protection (also see *Fauna Management Strategy*).

- Develop species list specific to Surrey. This would be a list of plants and wildlife that are native to Surrey, but that have been extirpated (eliminated from the region), threatened or endangered and whose habitats are within the City boundaries.
- This list can then be a resource when developing natural area parks, or natural areas within parks, with the goal of re-introducing species or increasing populations of threatened or endangered species.

Education and Awareness

At times, Surrey Parks has been criticized for inadequate maintenance of natural areas. However, this criticism is often based on the pervasive desire for cultivated landscapes within urban settings, and a general lack of awareness of the intricacies of natural ecosystems. The uncultivated and “messy” appearance of native vegetation is sometimes mistakenly depicted as “derelict.” A public education and awareness program could facilitate an understanding of the importance of the vegetation resource in urban areas.

- Develop an education and awareness campaign directed at changing public perceptions and attitudes, and increasing appreciation for natural areas. As part of the management program delivery, a campaign could utilize a host of information sources including brochures, local newspaper submissions and inserts.

Degraded Land Assessment

In Surrey, parkland can be described as “active use” areas for human-centred activities, natural areas with nature-centred values, and degraded lands with few nature or human-centred values. Degraded lands have the potential to be converted or developed as natural areas or as active use parkland. Many of the degraded lands if developed as natural areas could provide connections between existing natural areas, or for wildlife habitat interconnectivity.

A number of “former” natural areas have undergone significant changes which resulted in the loss of the native vegetation: sometimes as a result of development activity the area has been scarred and de-vegetated, virtually “moonscaped”; other times as a result of inadequate management that has allowed area conversion to primarily invasive species. Although some reforestation and tree planting occurs, the sites are not re-vegetated on a priority basis within the context of a comprehensive plan.

The development and implementation of any renovation plans is listed as “mid-range” in order to allow time for a comprehensive assessment of degraded park sites, their condition, and the subsequent cost analysis for re-vegetation and renovation. Therefore, when funding allows it is recommended that the Parks Division:

- Undertake the assessment of degraded lands for development, and give consideration to the creation of natural areas on these sites.
- Establish a renovation program to restore these degraded park sites to either their natural, or cultured state.
- Re-vegetate to ensure appropriate distribution of species and age class of species. This is an important component in the provision of wildlife habitat, integrity of hydrological systems, environmental enhancement, and soil erosion control.

Long-term Recommendations **3-5 years, or as resources allow**

The long-term recommendations for a comprehensive vegetation management strategy fall under three main categories—Site-Specific Plans and Programs, Provision Standards and Assessment. Each category contains more specific information on these prioritized initiatives.

Site-Specific Plans and Programs

Many natural areas, and some natural areas within parks, require site-specific vegetation management plans and programs. Sustainability of the vegetation resource at specific sites may be threatened for a variety of reasons, have high ecological sensitivity, or competing interests. The sheer size of the site itself may dictate the need for a site-specific plan.

In order to properly maintain the vegetation resource and preserve natural areas ecosystems the following is recommended:

- Develop site-specific management plans to provide direction for the Parks Division in the management of the vegetation resource. Such plans will also allow for better

communication with the public, which could help to facilitate better conflict resolution when the values of access and recreation for the public, collide with the values of habitat provision for the vegetation and fauna.

Provision Standards

The *Parks, Recreation and Culture Master Plan* suggests a provision standard of .8 hectares (2 acres) of Nature Preservation and Linkage Parks per 1000 residents. This classification is often construed to be a provision level for natural areas, whereas many of the lands included in the present inventory of “Nature Preservation Areas and Linkages” are not natural areas according to the definition within the *Natural Areas Management Plan*. More often they are utility corridors, or linear parks of non-native grasses with limited natural area attributes.

- A review of the different land classification systems used for park planning is recommended, with the goal of achieving a common approach to land classification between planners and natural area land managers. This, in turn, would enable a more comprehensive understanding of what provision standards currently exist, and assist with the determination of a more specific standard.
- It is necessary to conduct detailed analysis of current Nature Preservation and Linkage classified parks to determine what percentage are natural areas as defined in this Strategy. This analysis would help guide park acquisition strategies that are founded on the need to provide for natural areas.
- Detailed provision standards should be developed that consider natural area spatial distributions of the various site classifications (e.g. grasslands, wetlands, old-field, shrublands, hedgerows, etc.). This would assist in long-term planning and acquisition strategies.
- Natural area acquisition strategies should consider senior level government reports such as the Ministry of Environment, Lands and Parks, *Sensitive Ecosystem Inventory* as a valuable source of information.

Natural Area Fragmentation

The health of natural area vegetation is optimal when natural ecosystems function better, and they generally function better when they are large in area and are not dissected by an overburden of development, such as trails and roads. Wildlife moves more easily through natural areas when corridors are established that bridge urban infrastructure such as roads.

Fragmentation of natural ecosystems has occurred along a variety of scales in Surrey. On a regional scale, the dissecting of ecosystems is often an outcome of the establishment of local government geopolitical boundaries. Although the Greater Vancouver Regional District works diligently at preserving large tracts of natural areas that sometimes span more than one geopolitical area, and local governments sometimes do collaborate on creating inter-connected recreational and natural systems, inevitably natural ecosystems are fragmented.

On a local scale, that being within the boundaries of the City of Surrey, fragmentation of natural area ecosystems further occurs simply through the act of building the City for human occupancy. Often the fragmentation could be avoided through increased consideration to the requirements of large-scale natural ecosystems.

At the ‘park’ scale there is sometimes a penchant to create natural area islands within the park, separated by linear passive lawn areas, ostensibly for aesthetics reasons. This separation further fragments natural ecosystems, diminishing their values and function as natural systems.

It is recommended that:

- Surrey park planning processes, within the regional and local context, give consideration to the need to preserve large tracts of natural ecosystems and interconnecting natural ecosystems whenever possible for the sake of the ecosystems themselves.
- Park site design and development should consider the need to interconnect adjacent natural ecosystems and avoid disconnecting natural areas within the park.
- Parks undertake an assessment of existing parks to identify where natural areas within the parks can be reconnected through additional planting or alternative maintenance practices (i.e., no mowing) to reduce fragmentation..

Appendix A:

Rare and Endangered Natural Plant Communities

The following rare natural plant communities list was generated from the B.C. Conservation Data Centre's tracking list for the Chilliwack Forest District. This tracking list is currently incomplete because there is not enough data yet to rank all of the rare natural plant communities in B.C. Tracking lists information is subject to change because they are being updated continually. The list below represents only those communities on the tracking list (as of August 2000) that are believed to currently exist in Surrey or that may have existed here in the past. The status of each plant community on the provincial list is given as either red or blue listed. Red listed plant communities are extirpated, endangered or threatened. Blue listed plant communities are vulnerable or at risk. The structural stage is listed (see table below) because similar plant communities at younger structural stages are considered to be different plant communities, though they may eventually develop into one of the rare natural plant communities.

Code	Structural Stage	Code	Structural Stage
1	Sparse/bryoid	3	Shrub/Herb
1a	Sparse	3a	Low shrub
1b	Bryoid	3b	Tall shrub
2	Herb	4	Pole/Sapling
2a	Forb-dominated	5	Young Forest
2b	Graminoid-dominated	6	Mature Forest
2c	Aquatic	7	Old Forest
2d	Dwarf shrub-dominated		

At some point in the future many of the larger natural areas in the parks system will be classified at the biogeoclimatic ecosystem level. Once this is accomplished, the information can be checked against this list to determine the relative priority of these ecosystem types for protection, enhancement and new parkland acquisitions.

Scientific Name	English Name	Biogeoclimatic Ecosystem Classification Unit	Provincial List	Structural Stage
<i>Abies grandis</i> / <i>Mahonia nervosa</i>	Grand fir / dull Oregon-grape	CDFmm / 04	Red	7
<i>Abies grandis</i> / <i>Tiarella trifoliata</i>	Grand fir / three-leaved foamflower	CDFmm / 06	Red	7
<i>Alnus rubra</i> / <i>Carex</i>	Red alder / slough sedge	CDFmm / 14	Red	6

Scientific Name	English Name	Biogeoclimatic Ecosystem Classification Unit	Provincial List	Structural Stage
<i>obnupta</i> [<i>Populus balsamifera</i> ssp. <i>trichocarpa</i>]	[black cottonwood]			
<i>Alnus rubra</i> / <i>Lysichiton americanum</i>	Red alder / skunk cabbage	CDFmm/11	Blue	7
<i>Deschampsia cespitosa</i> – <i>Sidalcea hendersonii</i>	Tufted hairgrass – Henderson’s checker-mallow	CWHxm1/00	Red	2
<i>Festuca idahoensis</i> – <i>Koeleria macrantha</i>	Idaho fescue - junegrass	CDFmm/00 CWHxm1/00	Red	2
<i>Festuca idahoensis</i> – <i>Koeleria macrantha</i>	Idaho fescue - junegrass	CWHxm1/00	Red	2
<i>Myosurus minimus</i> – <i>Montia</i> spp. – <i>Limnanthes macounii</i>		CDFmm/00	Red	2
<i>Picea sitchensis</i> / <i>Rubus spectabilis</i> Dry	Sitka spruce / salmonberry Dry	CWHdm/08	Red	7
<i>Picea sitchensis</i> / <i>Rubus spectabilis</i> Very Dry Maritime	Sitka spruce / salmonberry Very Dry Maritime	CWHxm1/08	Red	7
<i>Populus balsamifera</i> ssp. <i>trichocarpa</i> / <i>Cornus stolonifera</i>	Black cottonwood / red-osier dogwood	CWHdm/09	Blue	6
<i>Populus balsamifera</i> ssp. <i>trichocarpa</i> / <i>Cornus stolonifera</i>	Black cottonwood / red-osier dogwood	CWHxm1/09	Blue	6
<i>Pseudotsuga menziesii</i> – <i>Pinus contorta</i> / <i>Holodiscus discolor</i> / <i>Cladina</i>	Douglas-fir – lodgepole pine/oceanspray/cladina	CWHdm/02	Red	7
<i>Pseudotsuga menziesii</i> – <i>Pinus contorta</i> / <i>Rhacomitrium canescens</i>	Douglas-fir – lodgepole pine / rhacomitrium	CWHxm1/02	Red	7
<i>Pseudotsuga menziesii</i> – <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> Dry Maritime	Douglas-fir – western hemlock / salal Dry Maritime	CWHxm1/03	Blue	7
<i>Pseudotsuga menziesii</i> – <i>Tsuga heterophylla</i> / <i>Gaultheria shallon</i> Dry Maritime	Douglas-fir – western hemlock / salal Dry Maritime	CWHdm/03	Blue	7
<i>Pseudotsuga menziesii</i> / <i>Gaultheria shallon</i>	Douglas-fir / salal	CDFmm/01	Red	7

Scientific Name	English Name	Biogeoclimatic Ecosystem Classification Unit	Provincial List	Structural Stage
<i>Pseudotsuga menziesii</i> / <i>Polystichum munitum</i>	Douglas-fir / sword fern	CWHxm1/04	Red	7
<i>Pseudotsuga menziesii</i> / <i>Polystichum munitum</i>	Douglas-fir / sword fern	CWHdm/04	Red	7
<i>Sidalcea hendersonii</i> – Tidal Marsh	Henderson’s checker-mallow – Tidal Marsh	CWHxm1/00	Red	
<i>Thuja plicata</i> – <i>Pseudotsuga menziesii</i> / <i>Kindbergia oregana</i>	Western redcedar – Douglas-fir / Oregon beaked moss	CDFmm/05	Red	7
<i>Thuja plicata</i> / <i>Achlys triphylla</i>	Western redcedar / vanilla leaf	CDFmm/12	Red	7
<i>Thuja plicata</i> / <i>Carex obnupta</i>	Western redcedar / slough sedge	CWHxm1/15	Blue	6
<i>Thuja plicata</i> / <i>Carex obnupta</i>	Western redcedar / slough sedge	CWHdm/15	Blue	6
<i>Thuja plicata</i> / <i>Lonicera involucrata</i>	Western redcedar / black twinberry	CWHxm1/14	Red	6
<i>Thuja plicata</i> / <i>Lonicera involucrata</i>	Western redcedar / black twinberry	CWHdm/14	Red	6
<i>Thuja plicata</i> / <i>Oemleria cerasiformis</i>	Western redcedar / Indian-plum	CDFmm/13	Red	7
<i>Thuja plicata</i> / <i>Polystichum munitum</i> Dry Maritime	Western redcedar / swordfern Dry Maritime	CWHdm/05	Blue	7
<i>Thuja plicata</i> / <i>polystichum munitum</i> Very Dry Maritime	Western redcedar / swordfern Very Dry Maritime	CWHxm1/05	Blue	7
<i>Thuja plicata</i> / <i>Rubus spectabilis</i>	Western redcedar / salmonberry	CWHxm1/13	Red	6
<i>Thuja plicata</i> / <i>Rubus spectabilis</i>	Western redcedar / salmonberry	CWHdm/13	Red	6
<i>Thuja plicata</i> / <i>Symphoricarpos albus</i>	Western redcedar / snowberry	CDFmm/07	Red	7
<i>Thuja plicata</i> / <i>Tiarella trifoliata</i> Dry Maritime	Western redcedar / three-leaved foamflower Dry Maritime	CWHdm/07	Blue	7
<i>Thuja plicata</i> / <i>Tiarella trifoliata</i> Very Dry Maritime	Western redcedar / three-leaved foamflower Very Dry Maritime	CWHxm1/07	Red	7
<i>Tsuga heterophylla</i> - <i>Pseudotsuga menziesii</i> /	Western hemlock - douglas-fir / oregon beaked moss	CWHxm1/01	Red	7

Scientific Name	English Name	Biogeoclimatic Ecosystem Classification Unit	Provincial List	Structural Stage
<i>Kindbergia oregana</i>				
<i>Tsuga heterophylla</i> - <i>Thuja plicata</i> / <i>Blechnum spicant</i>	Western hemlock - western redcedar / deer fern	CWHdm/06	Red	7
<i>Tsuga heterophylla</i> - <i>Thuja plicata</i> / <i>Blechnum spicant</i>	Western hemlock - western redcedar / deer fern	CWHxm1/06	Red	7
<i>Tsuga heterophylla</i> / <i>Plagiothecium</i> <i>undulatum</i>	Western hemlock / flat moss	CWHdm/01	Red	7

Appendix B:

Rare and Endangered Plant Species

The following tracking list of rare and endangered plants was provided by the British Columbia Conservation Data Centre (CDC) and represents the most up-to-date information (April 2001) for the Chilliwack Forest District. Surrey constitutes a small fraction of the Chilliwack Forest District, so it is possible that some of the species listed here have never occurred in Surrey. Species with provincial 'Red' list status are extirpated, endangered or threatened. Species with provincial 'Blue' listed status are considered to be vulnerable or at risk.

This list could be used in the context of an ecosystem-based approach to the management of natural areas. If an area being rehabilitated (planted) is determined to be an appropriate ecosystem for one or more of these species, they could be planted to help maintain or enhance the population of these species in Surrey Parks.

Scientific Name	English Name	Provincial Listing
<i>Alopecurus carolinianus</i>	Carolina meadow foxtail	Red
<i>Anemone drummondii</i> var. <i>drummondii</i>	Drummond's anemone	Blue
<i>Anemone virginiana</i> var. <i>cylindroidea</i>	riverbank anemone	Red
<i>Apocynum x floribundum</i>	western dogbane	Blue
<i>Arabis lignifera</i>	woody-branched rockcress	Blue
<i>Asplenium adulterinum</i>	corrupt spleenwort	Blue
<i>Berula erecta</i>	cut-leaved water-parsnip	Red
<i>Bidens amplissima</i>	Vancouver Island beggarticks	Blue
<i>Cacaliopsis nardosmia</i>	silvercrown	Red
<i>Callitriche heterophylla</i> ssp. <i>heterophylla</i>	two-edged water-starwort	Blue
<i>Caltha palustris</i> var. <i>palustris</i>	yellow marsh-marigold	Blue
<i>Cardamine parviflora</i> var. <i>arenicola</i>	small-flowered bitter-cress	Red
<i>Carex amplifolia</i>	bigleaf sedge	Blue
<i>Carex comosa</i>	bearded sedge	Blue
<i>Carex feta</i>	green-sheathed sedge	Blue
<i>Carex interrupta</i>	green-fruited sedge	Red
<i>Carex lenticularis</i> var. <i>lenticularis</i>	lakeshore sedge	Red
<i>Carex scoparia</i>	pointed broom sedge	Blue
<i>Carex vulpinoidea</i>	fox sedge	Blue
<i>Castilleja rupicola</i>	cliff paintbrush	Blue
<i>Centaurium muehlenbergii</i>	Muhlenberg's centaury	Red
<i>Cephalanthera austiniiae</i>	Austin's phantom orchid	Red
<i>Cheilanthes gracillima</i>	lace fern	Blue
<i>Cimicifuga elata</i>	tall bugbane	Red
<i>Claytonia rubra</i> ssp. <i>depressa</i>	red miner's lettuce	Red
<i>Claytonia washingtoniana</i>	Washington miner's lettuce	Red
<i>Coleanthus subtilis</i>	northern coleanthus	Red

Scientific Name	English Name	Provincial Listing
<i>Crepis atribarba</i> ssp. <i>atribarba</i>	slender hawksbeard	Red
<i>Crepis occidentalis</i> ssp. <i>pumila</i>	western hawksbeard	Red
<i>Cryptogramma cascadiensis</i>	Cascade parsley fern	Blue
<i>Cuscuta pentagona</i>	five-angled dodder	Blue
<i>Delphinium glareosum</i>	rockslide larkspur	Red
<i>Dicentra uniflora</i>	steer's head	Blue
<i>Douglasia laevigata</i> var. <i>ciliolata</i>	smooth douglasia	Blue
<i>Draba lonchocarpa</i> var. <i>thompsonii</i>	lance-fruited draba	Blue
<i>Elatine rubella</i>	three-flowered waterwort	Blue
<i>Eleocharis parvula</i>	small spike-rush	Blue
<i>Eleocharis rostellata</i>	beaked spike-rush	Blue
<i>Elmera racemosa</i> var. <i>racemosa</i>	elmera	Blue
<i>Elodea nuttallii</i>	Nuttall's waterweed	Blue
<i>Epilobium ciliatum</i> ssp. <i>watsonii</i>	purple-leaved willowherb	Blue
<i>Epilobium glaberrimum</i> ssp. <i>fastigiatum</i>	smooth willowherb	Blue
<i>Epilobium halleanum</i>	Hall's willowherb	Blue
<i>Epilobium leptocarpum</i>	small-flowered willowherb	Blue
<i>Epilobium mirabile</i>	hairy-stemmed willowherb	Blue
<i>Eriophorum vaginatum</i> ssp. <i>vaginatum</i>	sheathed cotton-grass	Blue
<i>Galium mexicanum</i> ssp. <i>asperulum</i>	rough bedstraw	Blue
<i>Gayophytum humile</i>	dwarf groundsmoke	Blue
<i>Glyceria leptostachya</i>	slender-spike manna grass	Blue
<i>Glyceria occidentalis</i>	western mannagrass	Blue
<i>Helenium autumnale</i> var. <i>grandiflorum</i>	mountain sneezeweed	Blue
<i>Helianthus nuttallii</i> var. <i>nuttallii</i>	Nuttall's sunflower	Red
<i>Hydrophyllum tenuipes</i>	Pacific waterleaf	Blue
<i>Hypericum majus</i>	Canadian St. John's-wort	Blue
<i>Hypericum scouleri</i> ssp. <i>nortoniae</i>	western St. John's-wort	Blue
<i>Idahoia scapigera</i>	scalegod	Red
<i>Juncus oxymeris</i>	pointed rush	Blue
<i>Juncus regelii</i>	Regel's rush	Blue
<i>Leersia oryzoides</i>	rice cutgrass	Blue
<i>Lewisia tweedyi</i>	tweedy's lewisia	Red
<i>Lilaea scilloides</i>	flowering quillwort	Blue
<i>Lindernia dubia</i> var. <i>anagallidea</i>	false-pimpernel	Red
<i>Lomatium brandegeei</i>	Brandegee's lomatium	Blue
<i>Lupinus arbustus</i> ssp. <i>pseudoparviflorus</i>	Montana lupine	Red
<i>Lupinus argenteus</i> var. <i>laxiflorus</i>	silvery lupine	Red
<i>Lupinus rivularis</i>	stream-bank lupine	Red
<i>Melica bulbosa</i>	oniongrass	Red
<i>Melica smithii</i>	Smith's melic	Blue
<i>Mimulus breweri</i>	Brewer's monkey-flower	Blue
<i>Mitella caulescens</i>	leafy mitrewort	Blue
<i>Muhlenbergia filiformis</i>	pull-up muhly	Red
<i>Myriophyllum pinnatum</i>	pinnate water-foil	Red
<i>Myriophyllum ussuriense</i>	Ussurian water-milfoil	Blue
<i>Navarretia intertexta</i>	needle-leaved navarretia	Red
<i>Nothochelone nemorosa</i>	woodland penstemon	Blue
<i>Platanthera dilatata</i> var. <i>albiflora</i>	fragrant white rein orchid	Blue

Scientific Name	English Name	Provincial Listing
<i>Polemonium elegans</i>	elegant Jacob's-ladder	Blue
<i>Polygonum douglasii</i> ssp. <i>johnstonii</i>	sachaline knotweed	Red
<i>Polygonum hydropiperoides</i>	water-pepper	Blue
<i>Polygonum polygaloides</i> ssp. <i>kelloggii</i>	Kellogg's knotweed	Blue
<i>Polygonum punctatum</i>	dotted smartweed	Blue
<i>Polystichum kruckebergii</i>	Kruckeberg's sword fern	Blue
<i>Potamogeton nodosus</i>	long-leaved pondweed	Red
<i>Potamogeton oakesianus</i>	Oake's pondweed	Blue
<i>Potamogeton strictifolius</i>	stiff-leaved pondweed	Blue
<i>Pyrola elliptica</i>	white wintergreen	Blue
<i>Rubus lasiococcus</i>	dwarf bramble	Blue
<i>Rubus nivalis</i>	snow dewberry	Red
<i>Rupertia physodes</i>	California-tea	Blue
<i>Sagina decumbens</i> ssp. <i>occidentalis</i>	Western pearlwort	Blue
<i>Salix sessilifolia</i>	sessile-leaved sandbar willow	Blue
<i>Sanguisorba menziesii</i>	Menzies' burnet	Blue
<i>Scrophularia lanceolata</i>	lance-leaved figwort	Blue
<i>Smelowskia ovalis</i>	short-fruited smelowski	Blue
<i>Sparganium fluctuans</i>	water bur-reed	Blue
<i>Spergularia macrotheca</i> var. <i>macrotheca</i>	beach sand spurry	Blue
<i>Stellaria obtusa</i>	blunt-sepaed starwort	Blue
<i>Stellaria umbellata</i>	umbellate starwort	Blue
<i>Toxicodendron diversilobum</i>	poison oak	Blue
<i>Verbena hastata</i> var. <i>scabra</i>	blue vervain	Red
<i>Veronica catenata</i>	pink water speedwell	Red
<i>Viola howellii</i>	Howell's violet	Blue
<i>Viola purpurea</i> var. <i>venosa</i>	purple-marked yellow violet	Blue
<i>Wolffia borealis</i>	northern water-meal	Red

Appendix C:

Invasive Species List

Plant invasions have become increasingly recognized as a major threat to both natural and human-exploited ecosystems worldwide (R. Hobbs et al. 1994). The threat is greatest when the population of a given plant species reaches epidemic levels and begins to outcompete native vegetation or monopolize cleared landscapes. At this point a number of undesirable effects begin to arise. Invasive, non-native plants can modify ecosystems through:

- Suppression or local eradication of native plant species and their associated organisms
- Reduction in total native plant species diversity and numbers
- Modification of soil nutrients and pH
- Alteration of drainage patterns
- Declines in survival rates of native animals

Additionally, these species can cause:

- Damage to property
- Decreased aesthetic values
- Increased fuel loading that promotes wild-fires

Invasive plant species are introduced to natural areas in a variety of ways. For the most part, exotic non-native species are introduced in an area for horticultural or agricultural purposes. The mere presence of these plants in our landscape is not the problem; it is the uncontrolled spread of these plants into undesigned sites that is of concern.

The prime methods of dispersal of these species in Surrey appear to be:

- a) Dumping of residential yard and garden waste
- b) Incidental seed transport by humans and animals
- c) Root or runner creep onto adjacent sites
- d) Random seed dispersal by wind and water

Once these plants have been introduced to a site, their rate of spread is determined by:

- a) Species specific reproduction strategy
- b) Site and climatic conditions (e.g. disturbed sites)
- c) Relative amount of vegetative competition
- d) Direct human intervention, or lack thereof

Problem Species in Natural Area Parks in Surrey

Botanical Name	Common Name	Degree of Invasiveness	Habitat Type	Ecology	Habitat Values when endemic
<i>Rubus discolor</i>	Himalayan blackberry	Extreme	Forest edges, roadside, fields	Shade intolerant	Food, shelter
<i>Hedera helix</i>	English ivy	Extreme	Forest understory, tree	Shade tolerant	Negative
<i>Lamium maculatum</i>	Dead nettle	Extreme	Forest understory	Shade tolerant	Negative
<i>Lythrum salicaria</i>	Purple loosestrife	High	Wetlands, ditches	Shade intolerant	Negative
<i>Cytisus scoparius</i>	Scotch broom	High	Roadsides, meadows, open forest	Shade intolerant	Negative
<i>Convolvulus arvensis</i>	Morning Glory	High	Edges, roadsides, fields, disturbed sites	Shade intolerant	Negative
<i>Ilex aquifolium</i>	English holly	High	Forest understory, moist	Shade tolerant	Food (minor)
<i>Impatiens balsamina</i>	Himalayan balsam, Snapweed	Medium	Open areas, disturbed	Shade intolerant, moist	N/A
<i>Polygonum japonicum</i>	Japanese Knotweed	High	Open areas	Shade intolerant	N/A

Table will be supplemented upon further consultation with specialists.

Invasive Species Found in Surrey

The following is a list of the major invasive plant species found in the city of Surrey. Background information on the biology, ecological impact and removal/control methods is included.

Shrub Species: Himalayan Blackberry, Scotch Broom

Herbaceous Species: Purple Loosestrife, Morning Glory (Bindweed), Japanese Knotweed, English Ivy, Yellow Archangel (Dead nettle), English Holly, Himalayan balsam (Snapweed), and Periwinkle.

Individual Account of Shrub and Herbaceous Species

Shrub Species

Name: *Rubus discolor*

Family: Rose

Common Name(s): Himalayan Blackberry

Photo:

Description:

Himalayan Blackberry is perennial that grows in mounds up to 3 meters tall and can trail as far as 10 meters long the ground. Their long trailings can become rooted at the end. These can send out new runners allows the plant to spread further. Delicate white to pinkish flowers and blackberries appear in the summer months (berries are edible). The stems are four-angled with many curved prickles. The leaves are oval shaped, smooth green-above, and covered with white hairs below (Pojar and MacKinnon, 1994).

Habitat Type:

This species forms dense thickets, especially in wet areas, along streamsides and disturbed areas.

Life History:

There are three kinds of blackberries found in British Columbia: Trailing blackberry (*Rubus urinus*), Evergreen blackberry (*Rubus laciniatis*) and Himalayan blackberry. Trailing blackberry is a native species to BC, while Evergreen and Himalayan blackberries originated in Europe and Iran, respectively. Himalayan Blackberry is now widespread throughout Southwestern British Columbia. Thickets of this species can produce 7000-13,000 seeds per square meter. The seeds are contained in drupelets in the plants berries. These berries ripen and turn black during the summer and mummify during the winter. This process provides a year round source of food for birds and mammals. As a result, animals that feed on blackberries are responsible for dispersing this plants seed over a wide range. Passage of the seed through the birds digestive tract may improve germination. Seedlings depend on the availability of degraded and open habitat such as land neglected after cultivation, degraded pasture, and eroded soils along stream banks (<http://tncweeds.ucdavis.edu/esadocs/documents/rubudis.html>).

Ecological Impacts:

These thickets may hinder medium to large sized mammals in gaining access to water. Native plant species are often displaced as this species takes over areas.

Invasive Potential: Medium

Habitat Value: Some

Source of summer/winter food, nesting habitat for birds and small mammals; cover from predation, prevents humans access to fragile sites ie.streambanks.

Methods of Removal/Control:

Physical: hand pulling, grub up, cutting

Mechanical: chopping, cutting, mowing

Thermal: prescribed burning

Biological Control

(for technique specifics refer to: blackberry file or <http://tnc.weeds.edu>)

Site Rehabilitation:

Re-plant with native vegetation. Examples: Salmonberry, Thimbleberry, Red Elderberry

Soil treatment for disturbance during invasive species removal

Application of geotextiles

Application of mulch layer

Recommended monitoring and maintenance:

Monitoring is needed to determine the best and most effective management practices

Observation over time (minimum very six months)

Adaptive management to determine the best course of action.

Name: *Cytisus scoparius*

Family Name: Fabaceae

Common Name: Scotch Broom

Photo:

**Description:**

Scotch Broom is a deciduous shrub. It grows up to 3 meters tall with many thin, long and flexible, green branches. Leaves are small and alternate. Three leaves are found at the base of the branches with only simple leaflets further out. Its flowers are bright yellow, occasionally with a purplish tinge. On the mature plant, thousands of seed pods can be seen. These pods are brownish black, about 4 cm long and pop open, expelling several seeds.

Habitat Type:

Scotch Broom is a European plant originating in the Mediterranean area. It thrives in a Mediterranean climate with mild winters and dry summer such as that of Southwestern British Columbia. It establishes in open sites, disturbed sites (along roads), but will also invade natural meadows, thickets and open forests. Being a nitrogen-fixing plant, it can tolerate poor soil conditions. An area where it has had a great deal of impact is the Gerry oak meadow ecosystem on southern Vancouver Island. It has out-competed almost all of the wildflowers, threatening an already fragile and greatly reduced plant community.

(http://infoweb.magi.com/~ehaber/bc_broom.html).

Life History:

The dark seed pods of Scotch Broom contain up to nine seeds. These pods burst open when ripe with an audible pop. Broom is prolific: a single mature plant can produce up to 18,000 seeds annually. Banked seeds may remain viable for up to 30 years, and germinate when provided with disturbed conditions of open mineral soil. Germination may be enhanced by fire. It relies less heavily on water, wind, or animal distribution than do some other invasive plants, although its tough seed coat provides good protection from abrasion associated with water transportation. Broom is nitrogen-fixing, which assists in its establishment on poor and disturbed sites, and, in turn, its ability to out-compete native species. Broom is well suited to cope with water-related stress, having a deep taproot, a reduced leaf area, and photosynthetically active stems. A thick epidermal wax coating and the ability to abscise its leaves permit conservation of moisture. It is a primarily a early seral colonizer, which is eventually shaded out by native species. There is, however, a concern that its vigorous and prolific growth, and acidification of the soil, in fact prevents establishment of other species.

(http://infoweb.magic.com/~ehaber/bc_broom.html)

Ecological Impacts:

Various growth feature make this a very competitive plant. Native plant species are often displaced as this species takes over areas. This results in a loss of biodiversity. Soil quality is degraded as a result of acidification.

Large patches can be a fire hazard

Invasive Potential: High

Habitat Value: Some

Nesting habitat for birds, bank stabilization/reduced erosion.

Methods of Removal/Control:

Physical: pulling, (during the fall when soil is wet, all plants less than two years old
remove all roots)
cutting (don't cut in winter, cut below first lateral root, never cut if less than two
years old)

Thermal: burning (encourages germination of seeds in the bank, then use physical controls)

Biological: 2 fungi used - still in experimental stage
-replacement planting

Chemical; round-up

*or use of two techniques: ie cut and round-up
(refer to broom file for specific techniques)

Site Rehabilitation:

Replanting with native vegetation.
soil treatment required - broom acidifies the soil
Application of geotextiles
Application of mulch layer

Recommended monitoring and maintenance:

Routine monitoring of the site following treatment to determine if further controls are needed
(minimum every 6 month).

Herbaceous Species

Name: *Lythrum salicaria* **Family Name:** Lythraceae

Common Name(s): Purple Loosestrife, Swamp loosestrife

Photo:



Description:

A herbaceous perennial introduced from Eurasia that now commonly grows in many freshwater wetlands in North America. It grows 1 - 2 m high with a hairy and somewhat square shaped stem. It is mostly unbranched near base but branches out near top (Guard, 1995). A spike on the top of the plant contains many flowers. These flowers are bright purple-pink with tissue-like appearance. Leaves are opposite, 3 - 10 cm long (Pojar and Mackinnon, 1994).

Habitat Type:

Purple loosestrife inhabit wetlands, marshes, edges of large ponds and lakes, and river banks. It flourishes in wetland habitats that have been disturbed or degraded by either human activities or natural occurrences.

Life History:

This plant begins to bloom in July and continues until September or October. Its flowers can be pollinated by several types of bees and butterflies. Each Purple loosestrife plant can produce up to 900 seed capsules, holding an average of 120 orange, minute seeds (<http://webriver.com.tn-eppc/manual/lythru.htm>). These seeds are dispersed mainly by wind and water. However, waterfowl and wetland animals may also play a role in this process. The Red-winged Blackbird, for example, is known to eat these seeds and, thereby, aiding in the wide dispersal of the plant. Humans can carry seeds inadvertently on clothing and shoes.

Purple loosestrife seeds can germinate in a wide range of soils from acidic to alkaline or nutrient poor to nutrient rich. Light requirements for germination are minimal. These factors allow the plants to establish in a wide range of habitat conditions. Seedlings that germinate in the spring grow rapidly and will produce a floral shoot up to 30 cm in the first year. Once established, seedlings can survive shallow flooding of up to 30-45 cm in depth. A drop in water levels allow seeds of this species, which are held in large number in the seed bank, to germinate. The taproot of the plant is strongly developed and persists throughout the life of the plant becoming thick and woody. The semi-woody-aerial shoots die off in the fall but persist for one to two years making stands very thick (<http://tncweeds.ucdavis.edu>). Loosestrife can also spread through cut stems and, small pieces of rhizomes left in the ground. This plant has no natural predators, therefore, once it invades an area it is capable of out-competing all other species and eventually leads to a virtually monospecies stand. As this plant takes over, the ecosystem is changed and native wetland habitat is lost.

Ecological Impacts:

Replaces native vegetation, degrades wildlife habitat, decreases wetland habitat and obstructs natural waterways. Waterfowl can become trapped among the stems of these plants and die. Due to an absence of natural predators to control this plant, populations can taking over and dominate large areas.

Invasive Potential: High

Habitat Value: Low

Methods of Removal/Control:

Mechanical/Physical: hand pulling; shearing, mowing, mowing, water level manipulation, burning, polishing/disking - not effective

Chemical: herbicides (problem - non-selective chemicals)

suggested -roundup, triclopyrpyramine (take caution when using near watercourses)

Biological: plants, insects (beetles, weevils) -still experimental

* for large infestations. -containment and seed production are best measures.

Site Rehabilitation:

Recommended replacement species include: Nodding smartweed; Walter's millet; Japanese; and chufa. Vegetating plants should be used in conjunction with the various removal and control methods. Application of geotextiles

Recommended monitoring and maintenance:

Site survey every 6 months for changes in population size

If possible maintain a steady water level in the wetland

Try to remove all rhizomes

Methods of control will vary depending on the size of infestation.

Name: *Convolvulus arvensis*

Family Name: Convolvulaceae

Common Name: Morning Glory, Bindweed, Field Bindweed

Photo:

Description:

Morning Glory is a perennial vine which spreads by rhizome and seeds. It trails and twines to lengths of 20 to 200 cm forming carpets that are capable of strangling other vegetation. Underground rhizomes may range from 5 cm to 2.6 m long. The extensive roots can measure 6.6m long and penetrate deeply into the soil. Leaves are arrowhead in shape, 2 to 6 cm long and are alternating. Its flowers consist of five fused pedals forming a 2 to 2.5 cm long funnel. They are white with a very pale pink tinge (Pojar and (Mickinnon, 1996).

Habitat Type:

Field Bindweed/Morning Glory is an introduced species from Europe. However, there are native Morning Glory species (Nightblooming) found in British Columbia. Both native and non-native plants are commonly found in fields, croplands, thickets, roadsides, streambanks, lakeshores, disturbed area and waste places.

Life History:

Morning Glory flowers are produced in June and plants continue to bloom as long as the growing conditions are favorable. These flowers last for only one day. The underground root and stem system is quite extensive. Young plants extend a taproot into the soil and then form lateral roots. These lateral roots initially function as feeding roots for above and below ground growth but later aid in vegetative reproduction. Eventually a long series of shoots arise from the stem. Seeds fall near the parent plant but can be transported by water or bird. Seeds can remain viable in the stomachs of migrating Killdeer for up to 144 hours, and pass through animals with little or no damage. Thirty days after pollination the seed matures. Seeds may lie dormant in the soil for many years until favorable germinating conditions are met (Lyons, TNC).

Ecological Impacts:

Morning Glory (Field Bindweed) is an aggressive vine that often twines or wraps around other vegetation or objects. This can lead to other species being choked out or severely damaged as they engulfed by this plant. Ultimately, this will lead to a decrease in area biodiversity.

Invasive Potential: Medium

Habitat Value: Low

Methods of Removal/Control:

Physical: pulling, mowing, disking, cultivating (these need to be repeated regularly)

-may be hard to put/uproot this plant without disturbing other vegetation - it twines around other plants.

Biological: competitive planting (species that grow fast in winter and early spring may have a chance)
(Refer to folder)

Site Rehabilitation:

Re-planting with native vegetation

Soil treatment - soil may be disturbed during pulling.

Application of geotextiles

Application of mulch layer

Recommended monitoring and maintenance:

Reduce seed in soil

Prevent seedling growth

Deplete food reserves in root system

Prevent spread of weed

Control methods such as cultivating will need to be applied frequently and regularly.

Name: *Polygonum cuspidatum* **Family Name:**

Common Name: Japanese knotweed, Mexican bamboo, Chinese bamboo

Photo:

Description:

Knotweed is a herbaceous perennial which forms large clumps 1-3 meters high. It is fully dioecious and can reproduce by seed and by large rhizomes which may reach a length of 5-6 meters. The stout stems are hollow and bamboo-like. They extend from an erect base and are simple or little branched with thinly membranous sheaths. Knotweed has egg-shaped, abruptly pointed leaves that are squared off at the base (Pojar and Mackinnon, 1994). Flowers are numerous in small panicles in the upper leaf axils and are approximately 3 mm long (Seiger, TNC).

Habitat Type:

Japanese Knotweed is native to eastern Asia. It found its way to North America, via the United Kingdom, in the late nineteenth century. It can thrive in a variety of habitats with a wide range of soil types. It is usually found in sunny places along river banks, wetlands, waste places, along roadways, and in other disturbed areas.

Life History:

Japanese Knotweed flowers in August and September in North America. It is pollinated by bees and other insects. Seeds appear two weeks after flowering and are wind dispersed. However, for the North America version of this plant, the seeds are not a significant mode of reproduction. Populations of fertile male plants are rare in this part of the world. As a result, the primary mode of reproduction is through extensive rhizomes which can reach 15-20 meters in length. Knotweed is a strong grower with the ability to regenerate from small fragments. Dispersal can occur naturally when rhizome fragments are washed downstream by the current and deposited on banks or, as more commonly occurs, when soil is transported by humans as fill. This plant out-competes other vegetation by emerging early in the spring and using its extensive rhizomatous reserves to quickly attain a height of 2-3 meters. Shoots generally emerge in April and growth rates can exceed 8 cm per day. In addition, its deep root system gives it an advantage in foraging for nutrients and water. (Seiger, <http://tncweeds.ucdavis.edu>)

Ecological Impacts:

This species can out-compete native vegetation that grows in riparian areas. Loss of these native riparian vegetation species can have an impact on the entire watercourse (decrease in area biodiversity, changes in stream ecology ie. more sunlight on streams).

Invasive Potential: Medium

Habitat Value: Low

Methods of Removal/Control:

Physical: hand pulling, - probably the best method, need to be done at least three times over growing season to be effective

 digging up disturbs soil and is hard to get all of rhizomes - not recommended.

 shading - black polyethylene film covered with asphalt or stone - expensive

Chemical: 1) roundup works best in combo with cutting. undesirable for use in conservation areas, near water, etc. Persist in soil and are non-selective. Paint on plant to eliminate or reduce these problems.

 2) Picloram - different. chemicals for use during different seasons

Site Rehabilitation:

Re-vegetate with early sprouting, fast growing, native species once growth of Japanese Knotweed has been reduced (attempt to shade it out).

Application of geotextiles
Application of mulch layer

Recommended monitoring and maintenance:

Monitor for the introduction of Japanese Knotweed and manually remove the entire plant.
(every 6 months)

Repeated cutting and proper disposal of wastes.
(as long as rhizomes remain in the soil Knotweed returns once management is relaxed)

Name: *Hedera helix*

Family Name:

Common Name: English Ivy

Photo:

Description:

English Ivy is an evergreen woody vine that blankets the ground and climbs walls, fences, trees or trellises. If left un-attended it can overtake and smothers surrounding vegetation. Its leaves alternate along the stem and are green with white to grey-ish markings. They are leather-like and have 3-5 lobes. The flowers of this plant are small and yellow (http://www.rbg.ca/cbcn/i_control.html).

Habitat Type:

English Ivy grows in sun or shade in most climates. This Eurasian plant is commonly cultivated in North America as it is used in gardens and floral arrangements. It has escaped to open woods in southern British Columbia and southwestern Ontario. Ivy is also found in fields, old gardens and urban areas. It has been observed in many forested habitats throughout Surrey climbing high into mature trees.

Life History:

English Ivy has two life phase. In the first phase, juvenile phase, ivy plant produces aerial roots which allow the plant to climb and cling to almost any surface, including walls, posts or tree bark. Ivy has the ability to climb vertical surfaces to heights over 100 feet. If the plant is pruned or maintained at this early phase it will remain in the juvenile phase and continue to produce stems from the earlier wood. The second phase is known as the adult or reproductive phase. During this life phase the plant grows un characteristic oval leaves from stout stem that do not produce aerial roots. Instead the stems grow out from the surface it has been clinging to and annually produces flowers and umbels of black fruit.

Ecological Impacts:

English Ivy clings to and climbs other vegetation. As it wraps around trees it can become very dense, choking (girdling) the tree and blocking light from reaching the trees leaves. These stresses plus the added weight to the trees can heavily impact or even kill the tree. Along with Scotch Broom, English Ivy is heavily impacting the Gerry oak meadow ecosystem of southern Vancouver island as many native species are eliminated. Ivy can be spotted in many of Surrey's parks engulfing mature trees.

Invasive Potential: High

Habitat Value: Low

Nesting habitat for birds, discourages soil erosion.

Methods of Removal/Control:

Physical: hand pull, grub up (with shove/spade), shear

Site Rehabilitation:

Re-vegetate with native species
 Treatment of disturbed soils as a result of removal
 Treatment for damages to tree/vegetation resulting from invasive species.
 Application of geotextiles
 Application of mulch layer

Recommended monitoring and maintenance:

Routine monitoring of reclaimed site for re-sprouting of ivy plants (every 6 months).
 If the plant is regularly maintained so that it does not reach the adult phase fruits and flowers will not be produced. Thus, the plant will not reach the reproductive phase.

Name: *Lamiastrum galeobdolon* (*Lamium maculatum*)

Family Name: Mint

Common Name: Yellow Archangel, False Lamium, Dead nettle

Photo:

Description:

This is a semi-evergreen, herbaceous, perennial groundcover. It reaches maturity at about 1-1.5 feet tall and wide. Its growth habit tends to be in a mat or radiating clump and is at a slow rate. Leaves are opposite and ovate with an acute tip and are green with silver stripes down the midrib. Flowers are yellow with a hooded upper petal and lipped lower petal characteristic of the mint family. Stems are square, somewhat pubescent, and green (<http://www.hcs.ohio-state.edu/hcs/TMI/plantlist>).

Habitat Type:

It thrives in moist, but well-drained, rich soil in partial shade. However, it is tolerant of heat, occasionally dry soils, average soils, and soils of various pH levels.

Life History:

This species is native to Europe, however there are similar species to this that are native to North America. The leaves of this plant emerge in March and grow rapidly throughout April and May. During the winter months the entire plant slowly dies back to the ground green (<http://www.hcs.ohio-state.edu/hcs/TMI/plantlist>).

Ecological Impacts:

Nurseries commonly sell these plants in hanging baskets. They often escape from gardens and spread as a dense ground cover over the forest floor. They out-compete native vegetation, therefore leading to a loss in plant biodiversity.

Invasive Potential: High

Habitat Value: Low

Methods of Removal/Control:

Physical: hand pull, grub up (with shove/spade), shear
 *no literature found on proper eradication techniques

Site Rehabilitation:

Re-vegetate with native species
 Treatment of disturbed soils as a result of removal
 Treatment for damages to tree or other vegetation resulting from invasive species.
 Application of geotextiles
 Application of mulch layer

Recommended monitoring and maintenance:

Routine monitoring of reclaimed site for re-sprouting of plant (every 6 months)
Any plant not removed should be regularly maintained/pruned to prevent spread
They should not be purchased for garden plantings in Surrey parks.

Name: *Ilex aquifolium***Family Name:****Common Name:** Holly, English holly, Christmas holly**Photo:****Description:**

This holly is a broadleaf evergreen shrub/tree, 9-15 meters tall, dense, and pyramidal in shape. The leaves of this plant are 2,5-7.5 cm long and 2-6.5 cm wide. They are dark green and undulating with spiny margins. Dull, white, fragrant flowers appear in the spring. The fruit of the plant is bright red, 6 mm in diameter and persists into the winter (<http://www.bcc.orst.edu.horlpm/ilaq-i.htm>).

Habitat Type:

Holly can tolerate either sun or shade. Although semi-shade is preferable in mid-summer, the more light it has the more dense its foliage will be. Holly requires well-drained, slightly acid, fertile soil. It is found in low elevations on the coastal islands or adjacent mainland (Lyons and Merilees, 1995).

Life History:

The male and female flowers of the holly tree are produced on separate plants. Therefore, both male and female need to be present for berries to be produced. They need to be within 100 feet of each other for bees to successfully pollinate the female flowers and thereby produce the bright red berries that holly is known for (<http://www.thegardenhelper.com/holly.html>). Although it is a fairly slow spreading plant it is able to establish a strong foothold in the soil and eventually out-competes other vegetation types..

Ecological Impacts:

Spread as a dense ground cover over the forest floor over-taking other vegetation resulting in a loss of biodiversity.

Invasive Potential: Medium**Habitat Value:** Some

Food and nesting source for birds.

Methods of Removal/Control:

Physical: hand pulling, grub up, cutting
(no literature found that suggested specific control/removal techniques)

Site Rehabilitation:

Re-vegetate with native species
Treatment of disturbed soils as a result of removal
Application of geotextiles
Application of mulch layer

Recommended monitoring and maintenance

Routine monitoring of reclaimed site for re-sprouting of plant (every 6 months)
Any plant not removed should be regularly maintained/pruned to prevent spread

Name: *Impatiens balsamina* **Family Name:**
Common Name: Himalayan balsam, Snapweed, Touch-me-not
Photo:

Description:

This plant is 1-2 meters tall, flowers in clusters, red-pink to white with yellow spots, 3-4 cm long. Its stems are hairless, leaves are 6-20 cm long, toothed, opposite or whorled, lanceolate, fruit club shaped, 3 cm long (http://www.rbg.ca/cbcn/i_list.html).

Habitat Type:

This species originates from Europe and is now established in parts of Ontario and British Columbia. It thrives in moist areas including streambanks, bushy places, grazing grounds

Life History:

Ecological Impact

Invasive Potential: Medium

Habitat Value:

Methods of Removal/Control:

Physical: dug up or shear
(no literature found that suggested specific control/removal techniques)

Site Rehabilitation:

Re-vegetate with native species
Treatment of disturbed soils as a result of removal
Application of geotextiles
Application of mulch layer

Recommended monitoring and maintenance

Routine monitoring of reclaimed site for re-sprouting of plant (every 6 months)

Name: *Vinca minor* **Family Name:**

Common Name: Periwinkle, Myrtle

Photo:

Description:

Periwinkle is a herbaceous perennial, 30-60 cm high. Its flowers are blue/purple or white and 25-30 mm long. Leaves 25-40 mm long, elliptic, lanceolate and very short-stemmed (http://www.rbg.ca/cbcn/i_list.html).

Habitat Type:

Periwinkle is a Eurasian garden escape that has spread to lawns, roadsides, waste places, and open woods in southwest British Columbia, and southern Ontario to Nova Scotia. It thrives in moist, rich soils.

Life History:

Spreads as a ground cover over the forest floor.

Ecological Impacts:

Periwinkle has been rated as a limited invasive of a local nature that is stable, in a Canadian Botanical Conservation Network (CBCN) survey. It is very limited in impact, however, is capable of excluding other species and prevents regeneration.

Invasive Potential: Medium

Habitat Value:**Methods of Removal/Control:**

Physical: dig up, cutting, shear

Site Rehabilitation:

Re-vegetate with native species
Treatment of disturbed soils as a result of removal
Application of geotextiles
Application of mulch layers

Recommended monitoring and maintenance

Routine monitoring of reclaimed site for re-sprouting of the plant (every 6 months)
Any plant not removed should be regularly maintained/pruned to prevent spread.

Additional invasive species found in British Columbia

This information was taken from the Canadian Botanical Conservation Network.

Source: http://www.rbg.ca/cbcn/i_list.html

Herbaceous Species***Acinos arvensis***

Common Name(s): Mother-of-thyme

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, ON, QC, NF, NB, NS, PEI

Habitat : Roadsides, old fields, waste places

Description : Annual, 10-20 cm tall, purple flowers with white markings, 7-10 mm wide, leaves 5-15 mm long, ovate to elliptical, petiolate

Usage : Ornamental

Invasive Potential : Potentially invasive

Control Method(s) : girdle, shear and herbicide

Aegopodium podagraria

Common Name(s): Goutweed

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NB, NS

Habitat : Roadsides, waste places, habitations

Description : Perennial, 3-11 dm high, flowers in white, dense clusters, 6-12 cm wide, stems erect, leaves with long petioles, biternate with 9 leaflets, 2.5-9 cm long

Usage : Weed

Invasive Potential : L

Control Method(s) : hand pull and dig up

Alliaria petiolata

Common Name(s): Garlic mustard, Hedge garlic

Origin : Europe

Status : Available

Provincial Location(s) : BC, ON, QC

Habitat : Roadsides, open woods, near habitations

Description : Biennial, 1 m high, flowering stalk with terminal cluster of white flowers,

Usage : Weed

Invasive Potential : H

Control Method(s) : hand pull, shear, herbicide foliar spray

Additional Comments : Out competes native species, introduced 1879

Artemisia absinthium

Common Name(s): Absinth, Wormwood

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NB

Habitat : Roadsides, waste places, farm yards, pastures

Description : Perennial, 5-10 dm high, flowers yellow or purple disks, erect stems, leaves in clumps, silky-hoary, 2-3 pinnately parted

Usage :

Invasive Potential : L

Control Method(s) : dig up and shear

Additional Comments : Primarily a species of disturbed sites

Berteroa incana

Common Name(s): Hoary-alyssum

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NB, NS

Habitat : Fields, waste places, pastures, meadows

Description : Perennial, 3-7 dm high, white flowers with notched petals, pods with star-shaped hairs, leaves pale green, alternate, simple, lanceolate

Usage :

Invasive Potential : L

Control Method(s) : dig up and shear

Bromus inermis

Common Name(s): Smooth brome grass

Origin : Europe

Status : Available

Provincial Location(s) : BC, SK, AB, MB

Habitat : Prairies, meadows, roadsides, agricultural areas

Description : Perennial, 2 feet high, flowers in spikelets with 3-7 florets, large tufts

Usage : Grass

Invasive Potential : L

Control Method(s) : sheartional Comments : Invades prairies and native grasslands, introduced 1800

Butomus umbellatus

Common Name(s): Flowering Rush

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, AB, MB, ON, QC

Habitat : Shores, inlands, waterways, ditches

Description : Perennial, flowers reddish, white or pink, at top of stalk, short rhizome, leaves 1 m long, 1 cm broad, triangular, pointed

Usage : Wetland

Invasive Potential : L

Control Method(s) : None

Additional Comments : Reproduces by seed production and vegetative spread, introduced 1897

Carduus nutans

Common Name(s): Nodding thistle, Musk thistle

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NB, NS,

Habitat : Pastures, roadsides, waste places

Description : Biennial, 1-1.5 m high, purple disk flowers, 2 cm long, leaves alternate, stem spiky, erect

Usage : Weed

Invasive Potential : P

Control Method(s) : shear

Additional Comments: Forms dense stands

Centaurea maculosa

Common Name(s): Spotted knapweed

Origin : Europe

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF

Habitat : Mountain meadows

Description : Biennial, 2-3 feet high, hairy purple flowers, leaves alternate, deeply cut into narrow divisions

Usage :

Invasive Potential : P

Control Method(s) : dig up, shear

Additional Comments : Forms dense stands

Cirsium arvense

Common Name(s): Canada thistle, Creeping thistle

Origin : Europe

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NS, NB

Habitat : Roadsides, prairies, savannas, agricultural areas

Description : Perennial, 4 Feet high, flowers rose-purple, pink or white, numerous heads, stems erect and green , leaves alternate, irregularly lobed, spiny toothed

Usage : Weed

Invasive Potential : L

Control Method(s) : dig up, shear

Additional Comments : Crowds out native species, allelopathic, introduced 1700's

Convallaria majalis

Common Name(s): Lily-of-the-valley

Origin : Eurasia

Status : Available

Provincial Location(s) :

Habitat : Roadsides, abandoned yards, meadows

Description : Perennial, 5-20 cm high, perianth bell-shaped, white, small, nodding, leaves 2-3 basal , oblong, dark green, heart-shaped, pale red berries, 3-4 mm long

Usage : Ornamental

Invasive Potential : L

Control Method(s) : dig up

Additional Comments : Spreads vegetatively, poisonous when eaten

Dipsacus fullonum

Common Name(s): Teasel

Origin : Europe

Status : Available

Provincial Location(s) : BC, ON, QC

Habitat : Pastures, old fields, waste places

Description : Biennial, 2-6 feet high, flowers pink on egg-shaped pincushion, spiny stem, leaves opposite, 3-6 cm long, narrow

Usage :

Invasive Potential : L

Control Method(s) :hand pull, dig up

Euphorbia esula

Common Name(s): Leafy spurge, Wolf's milk, Faitour's Grass

Origin : Europe

Status :

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NS, PEI

Habitat : Fields, pastures, roadsides

Description : Perennial, 2-6 feet, flowers greenish yellow, grouped or scattered, leaves spirally arranged, 1-3 inches long

Usage : Weed

Invasive Potential : H

Control Method(s) : shear

Additional Comments : Poisonous to livestock, reproduces vegetatively, introduced 1800's

Galium mollugo

Common Name(s): White bedstraw, Cleavers, Wild madder

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, ON, QC, NF, NB, NS,

Habitat : Fields and roadsides, meadows, waste places

Description : Perennial, 4-10 dm high, white terminal flowers, stem erect, branched, 8 leaves in a whorl on stem

Usage : Grass

Invasive Potential : P

Control Method(s) :shear

Hesperis matronalis

Common Name(s): Dame's rocket, Dame's violet

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NS, PEI

Habitat : Roadsides, thickets, open woods

Description : Perennial, 40-90 cm high, flowers violet or white, stem hairy, leaves simple, oblong, ovate, hairy

Usage : Ornamental

Invasive Potential : L

Control Method(s) : [i_control.html - control](#)

Additional Comments : Frequently added to wildflower mixes

Hypericum perforatum

Common Name(s): St. John's Wort, Rosin rose, Tipton-weed

Origin : Europe

Status : Available

Provincial Location(s) : BC, ON, QC, NF, NS

Habitat : Meadows, forest openings, agricultural areas

Description : Perennial, 3-8 dm high, flowers numerous, yellow with black dots on margin, very leafy, opposite, simple, broad, less than 1 cm long leaves, red or purplish fruits

Usage :

Invasive Potential : L

Control Method(s) : dig up, shear

Additional Comments : May poison livestock, introduced 1793

Iris pseudacorus

Common Name(s): Yellow flag

Origin :

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NB, NS

Habitat : Wetlands, ditches, marshes

Description : Perennial, 0.5-1 m high, large yellow flowers, thick branches rhizome, sword-shaped leaves, 2 cm broad

Usage : Ornamental

Invasive Potential : P

Control Method(s) : dig up

Melilotus alba

Common Name(s): White sweet clover, Honey clover

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF

Habitat : Prairies, roadsides, meadows, agricultural lands

Description : Biennial, 1-2 m high, white flowers on spike like racemes, leaves laternate, trifoliolate

Usage : Forage crop

Invasive Potential : L

Control Method(s) : hand pull, dig up

Additional Comments : Primarily species of disturbed sites

Melilotus officinalis

Common Name(s): Yellow sweet clover

Origin : Eurasia

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF

Habitat : Prairies, roadsides, meadows, agricultural lands

Description : Biennial, 1-2 m high, yellow flowers on spike like racemes, leaves laternate, trifoliolate

Usage : Forage crop

Invasive Potential : L
 Control Method(s) : hand pull, dig up
 Additional Comments : Primarily species of disturbed sites

Myriophyllum spicatum

Common Name(s): Eurasian water milfoil, Spiked water milfoil
 Origin : Eurasia
 Status : Available
 Provincial Location(s) : BC, ON, QC
 Habitat : Ponds and streams, stagnant and running water
 Description : Perennial, 5 cm high, flowers in whorls of 4, leaves in whorls of 4
 Usage : Wetland
 Invasive Potential : H
 Control Method(s) : hand pull, increase drainage
 Additional Comments : Spreads vegetatively, displaces all other species, introduced 1960

Origanum vulgare

Common Name(s): Wild marjoram, Wintersweet, Organdy
 Origin : Eurasia
 Status : Available
 Provincial Location(s) : BC, ON, QC, NF, NB, NS
 Habitat : Roadsides, old fields, open woods
 Description : Perennial, 2-6 dm high, flowers in spiky clusters with large purplish bracts, stems erect or ascending, branched above
 Usage : Ornamental
 Invasive Potential : P
 Control Method(s) : dig up

Phragmites communis

Common Name(s): Common reed, Reed grass
 Origin : Europe
 Status : Available
 Provincial Location(s) : BC, AB, SK, MB, ON, QC, NB, YT, NT
 Habitat : Marshes, ditches, ponds
 Description : Perennial, 1-4 m high, tufted spike with white flowers, leaves attached by loose sheath
 Usage : Grass
 Invasive Potential : L
 Control Method(s) : shear
 Additional Comments : Forms sterile mats

Poa compressa

Common Name(s): Canada blue grass
 Origin : Eurasia
 Status : Available
 Provincial Location(s) : BC, AB, SK, MB, ON, QC, NF, NB, NS, YT, NT, PEI
 Habitat : Dry soils, sand dunes
 Description : Perennial, 15-40 cm high, flowers dense, spike like, 5-12 cm long, stems erect, runners
 Usage : Grass
 Invasive Potential : P
 Control Method(s) : shear, herbicide foliar spray

Poa pratensis

Common Name(s): Kentucky blue grass
 Origin : Eurasia

Status : Available

Provincial Location(s) : BC, AB, SK, MB, ON, QC, NF, NB, NS, YT

Habitat : Moist to dry soils, open woods, meadows

Description : Perennial, 30-100 cm high, 3-5 flowered spikelets, 3-6 mm long, tufted, stems erect, blades flat or folded, 2-4 mm wide

Usage : Grass

Invasive Potential : P

Control Method(s) : shear, herbicide foliar spray

Shrubs

Viburnum opulus

Common Name(s) : Guelder rose, European highbush cranberry

Origin : Eurasia

Status : Available

Provincial Location : BC, SK, AB, MB, ON, QC, NF

Habitat : Swamps and bogs, along streams, open woods, thickets

Description: 5 m high, yellow or white flowers, leaves opposite, 3 lobed, bright red berries

Invasive Potential : L

Usage : Ornamental

Control Methods : Girdle, shear and herbicide

Additional Comments : Shunned by wildlife, unpleasant taste

Cynanchum nigrum

Common Name(s) : Dog-strangling vine, Black swallowwort

Origin : Europe

Status : Available

Provincial Location : BC, ON, QC

Habitat : Old fields, pastures, fence rows, waste places

Description: Perennial, 5-15 dm high, 5 lobed purple flowers, stems twining, leaves opposite, simple, petioled, 8 cm long

Invasive Potential : H

Usage :

Control Methods : hand pull, dig up

Trees

Betula pendula

Common Name(s) : Silver birch, European white birch

Origin : Europe

Status : Available

Provincial Location(s) : BC, MB, ON, NS, PEI

Habitat : Disturbed quarries and bogs, wetlands

Description : 15 m high, flowers in long slender catkins, leaves 3-7 cm long, triangular or ovate, hairless, double-toothed, cones 2-4 cm long

Usage : Landscaping, Ornamental

Invasive Potential : L

Control Method(s) : girdle, shear and herbicide

Additional Comments : Displaces native flora, overshades

Pinus sylvestris

Common Name(s) : Scots pine, Scotch pine

Origin : Europe

Status : Available

Provincial Location(s) : BC, SK, AB, MB, ON, QC, NF, NB, NS, PEI

Habitat : Old fields, roadsides, open bogs, open woods

Description : 30 m high, needles evergreen, bundles of 2, 4-8 cm long, blue-green, cones conical to ovoid, 2.5-7 cm long
 Usage : Landscaping, Ornamental
 Invasive Potential : L
 Control Method(s) : girdle, shear and herbicide
 Additional Comments : Useless for most purposes

Populus alba
 Common Name(s) : White poplar
 Origin : Europe
 Status : Available
 Provincial Location(s) : BC, AB, SK, MB, ON, QC, NF
 Habitat : Beach habitats, urban areas
 Description : 30 m high, flowering catkins producing pollen, pre formed rhomboidal leaves, 3-5 lobed, blue-green
 Usage : Ornamental
 Invasive Potential : L
 Control Method(s) : girdle, shear and herbicide
 Additional Comments : Spreads vegetatively, hybridizes with native species

Rhamnus cathartica
 Common Name(s) : European buckthorn, Common buckthorn
 Origin : Europe
 Status : Available
 Provincial Location(s) : BC, SK, ON, QC, NS, PEI
 Habitat : Open woods, pastures, fence rows
 Description : 6-15 feet high, small green flowers, grouped or solitary, thorny, leaves 1-2 inches long, opposite, fruits green changing to black
 Usage : Ornamental
 Invasive Potential : H
 Control Method(s) : girdle, shear and herbicide
 Additional Comments : Excludes all native seedlings, spread by birds, introduced before 1913

Summary of Control Removal Techniques

Note: This is a general list. Techniques may vary depending on species, size of infestation, season and site characteristics.

Impact of each method should be considered before techniques are implemented.

Method	Style	Details	Notes
Physical	hand pull	-pull up stalk at ground level -do before seed set begins -easier to remove root when ground is moist	-remove root or resprouting may occur -any stems left to flower may re-seed site
	grub up	-use spade/shovel to loosen soil and dig up root system	- re-sprouting may occur if entire root is not remove -may cause soil disturbance
	shear	-cut stems close to ground level with snipper, shears, or chain saw	-suckers may emerge if not treated with herbicide

Method	Style	Details	Notes
	girdle	-remove bark and phloem layer for 10 cm band around trunk	-don't damage xylem layer, may encourage suckering -check girdle for re-development of bark
	increase drainage	grade dirt around area, create alternate water drainage paths	may cause site disturbance
	burning	burn entire infestation	-may cause some seeds to germinate -damages other vegetation
Mechanical	mowing disking plowing	need to be done regularly/frequent -up-roots plants	-compacts soil disturbed soil
Chemical	herbicide	dispense from squirt bottle or backpack sprayer	-use caution -spray exotic species when other species are dormant if possible
	herb/shear	-cut stem with shears, chain saw -apply herbicide from squirt bottle	monitor and retreat if necessary
Biological	insects	-weevil: used on Purple loosestrife - fungi: used on Scotch broom	-site and species specific -extensive research is needed before this method is implemented
Mix of Controls		-use of two or more of these methods	

Source <http://www.rbg.ca/cbcn/i_control.html>

References

Guard, B.J. *Wetland Plants of Oregon and Washington*. Alberta: Lone Pine Publishing, 1995.

Lyons, C.P., and B. Merilees. *Trees, Shrubs, and Flowers to Know in British Columbia and Washington*. Alberta: Lone Pine Publishing, 1995.

Pojar, J., and A MacKinnon. *Plants of Coastal British Columbia Including Washington, Oregon and Alaska*. Alberta: Lone Pine Publishing, 1994.

Lyons, K. Field Bindweed. The Nature Conservancy. Virginia: [].
<<http://tncweeds.ucdavis.edu/esadocs/polyasp.html>>

Seiger, L. Japanese Knotweed. The Nature Conservancy. Virginia: [].
<<http://tncweeds.ucdavis.edu/esadocs/convarve.html>>

<http://www.rbg.ca/abcn/I_control.html>

<http://www.rbg.ca/abcn/I_control.html>

<<http://tncweeds.ucdavis.edu/esadocs/documnts/rubidis.html>>

<<http://tncweeds.ucdavis.edu/esadocs/documnts/rubidis.html>>

<http://infoweb.magi.com/~ehaber/bc_broom.html>

<http://infoweb.magi.com/~ehaber/bc_broom.html>

<<http://webriver.com.tn-eppc/manual/lythru.htm>>

<<http://webriver.com.tn-eppc/manual/lythru.htm>>

<<http://tncweeds.ucdavis.edu>>

<<http://tncweeds.ucdavis.edu>>

<<http://www.hcs.ohio-state.edu/hcs/TMI/plantlist>>

<<http://www.bcc.orsl.edu.horlpm/ilaq-i.htm>>

<<http://www.bcc.orsl.edu.horlpm/ilaq-i.htm>>

<http://www.rbg.ca/abcn/I_list.html>