Invasive Plant Management Strategy
District of North Vancouver

March, 2015 Final Draft

Submitted to:

District of North Vancouver
355 West Queens Road
North Vancouver, BC
V7N 4N5

Submitted by:

Fiona Steele, RPBio
Michael Coulthard, RPBio, RPF
Nick Page, RPBio

DIAMOND HEAD
CONSULTING LTD.

Raincoast
Applied Ecology

Document: 2576575

Table of Contents

List of Tables

List of Figures

Executive Summary

More than two dozen species of non-native, invasive plants have established in the District of North Vancouver. Eradication of all invasive plants in the District is not realistic, feasible or necessary. However, invasive plants require management when they have the potential to cause significant social, ecological and economic impacts. This management strategy provides direction for the prevention, treatment and control of harmful invasive plants.

The District has been actively managing invasive plants on public land since 1998. This Strategy builds on a number of ongoing management initiatives that involve District staff from multiple departments, community volunteers and stewardships groups, specialized contractors, and collaboration with neighbouring jurisdictions.

Once established, invasive plants are difficult and costly to control. This Strategy aims to provide a framework and policy for strategic management of invasive plants in the District to meet five goals:

1. AWARENESS: Effectively communicate why invasive plants are a problem.
2. PREVENTION: Prevent new invasive plants from establishing and spreading.
3. DETECTION: Detect where invasive plants are growing early and accurately.
4. TREATMENT: Control invasive plants safely and effectively.
5. RESTORATION: Restore natural habitat affected by invasive plants.

An implementation plan for the Strategy provides a prioritized sequence of actions to accomplish the Strategy's goals and objectives. The highest priority recommendations include:

- Strengthening internal communication between staff and departments managing invasive plants by forming an internal, inter-departmental *Staff Invasive Plant Working Group*.

- Building awareness of the problem by devising and implementing an invasive plant awareness campaign.

- Encouraging private land owners to manage invasive plants on their property by education and assessing options for a new District bylaw specific to the control of high risk invasive plant species, and formalizing the inclusion of invasive plant management in the development process.

- Preventing green waste dumping and park encroachment by educating residents and landscape contractors about the Park Control Bylaw, consequences of infraction, and the cost of green waste dumping and park encroachment.

- Setting treatment priorities by evaluating species risk and treatment feasibility.

- Applying the principles of Integrated Pest Management (IPM), provincial standards, and best management practices in all invasive plant control work.

PART A: CONTEXT – The Case for Invasive Plant Management

1 What are invasive plants?

Invasive plants are those that occur outside of their natural range and have significant ecological, social and/or economic impacts once established[1]. Introduced (i.e. exotic) plants are common in our landscapes and most are either unable to adapt to local conditions or, if they do establish, do not cause significant impacts. However, a minority of introduced plants are considered "invasive" because they are able to flourish and spread rapidly[2]. When invasive plants are not regulated by natural predators and other controls, they can cause significant impacts:

SOCIAL IMPACTS

Invasive plants can impact human health and aesthetic values and interfere with recreation opportunities. For example, giant hogweed is found in North Vancouver and when skin comes into contact with the sap, and is exposed to sunlight, severe burns result. If the sap gets into eyes it can cause temporary or sometimes permanent blindness. Children and dogs are particularly vulnerable because of their height and tendency to stray from trails.

ECOLOGICAL IMPACTS

Invasive plants can devastate native ecosystems, forming dense monocultures that out-compete or exclude native flora and fauna. For example, gorse acidifies surrounding soils, preventing native species from growing. Invasive plants can lead to a loss of native biodiversity, decreased species richness and altered ecosystem function[3]. Species and ecosystems at risk are particularly vulnerable to these impacts because of their limited populations and specific habitat requirements. Disruption of ecosystem function can also alter the landscape for native pollinators by attracting them to invasive plants and reducing the reproductive capacity of native plants[4]. This in turn may reduce the availability of habitat needed for survival of animal species.

ECONOMIC IMPACTS

Invasive plants are associated with wide ranging economic impacts across a range of sectors in Canada. Establishment within an urban landscape can lead to degradation and loss of productive land, damage to infrastructure and property, and reduced property values. Within the District of North Vancouver (District) knotweed species[5] have the greatest potential to have high economic costs because of the damage it can pose to property, infrastructure and

[1] Canadian Food Inspection Agency. Invasive Alien Plants in Canada – Summary Report.
[2] Lockwood, J.L., P. Cassey, and T. Blackburn. 2005. The role of propagule pressure in explaining species invasions. Trends in Ecology and Evolution. 20(5):223-228
[3] Costello et al. 2000. Effects of invasion by the indigenous shrub Acacia sopharae on plant composition of coastal grasslands in south-eastern Australia; Alvarez and Cushman. 2002. Community-level consequences of a plant invasion: effects on three habitats in coastal California.
[4] North American Pollinator Protection Campaign Wildlife Fact Sheet: Invasive Species. Retrieved October 15, 2014. https://pollinator.org/Resources/NAPPC%20Invasive%20Species%20Fact%20Sheet.pdf
[5] There are four species of knotweed occurring in the District. Japanese and Bohemian are the most common. Giant and Himalayan are far less common.

the environment. Knotweed can penetrate pavement, damaging roads, foundations and drainage systems, it can also clog waterways altering drainage patterns and causing flooding.

English ivy climbing a tree

Invasive plants spread by a variety of means: horticultural activities, improper disposal of waste, soil transfer, water movement, wind, and by 'hitching a ride' on vehicles, boats, bikes, people, animals and birds. Some invasive plants, such as English ivy and lamium, are still sold in nurseries and are often planted in maintained landscapes and gardens and spread into neighbouring properties and parks. Climate change may also increase BC's vulnerability to the arrival and establishment of new invasive plant species.[6]

Once established, invasive plants are difficult and costly to control. Invasive plants are, by nature, very effective at reproducing. In most cases successful treatment of an infestation will require repeated manual removals over multiple years. For a minority of species, manual removal is ineffective and sometimes even encourages further spread. This is the case for knotweed species, which have only been successfully treated by repeated applications of herbicide[7].

Understanding the invasion phase of an invasive plant species (degree of abundance and distribution across a landscape) is critical to determining an appropriate level of investment in management for the resulting reduction in impact[8].

Invasive plants are an emerging issue. This Strategy has been prepared using the best available information and will need to be updated on an ongoing basis.

2 Invasive Plants in the District of North Vancouver

There are over two dozen invasive plants of concern known to occur within the District at this time. The most abundant invasive plant species and their category of impacts (ecological, infrastructure, human health, or recreation) are listed in Table 1.

[6] Climate Change Impacts Research Consortium. Climate change and vulnerability to invasive plant species in British Columbia: The economics of an uncertain future. Retrieved December 20, 2013 from http://www.sfu.ca/ccirc/node/10

[7] In the District, chemical treatment of knotweed is confined to glyphosate (which is not a neonicotinoid). Where possible stem injection is used preferentially over foliar spray to reduce the risk of pesticide drift.

[8] Yokomizo et al. 2009. Managing the impact of invasive species: the value of knowing the density-impact curve. Ecological Applications, 19(2) pp. 376-386

Table 1. Most common invasive plant species found in the District and their general impact. Species are listed from highest to lowest abundance[9].

Common Name	Scientific Name	General Impact
English ivy	*Hedera helix*	Ecological, infrastructure
Himalayan blackberry	*Rubus armenicus*	Ecological, recreation
Lamium (yellow archangel)	*Lamium galeobdolon*	Ecological
Knotweed species	Primarily *Fallopia japonica* and *Fallopia x bohemica*	Ecological, infrastructure
Spurge laurel (daphne laurel)	*Daphne laureola*	Ecological, human health
English holly	*Ilex aquifolium*	Ecological, recreation
Cherry laurel	*Prunus laurocerasus*	Ecological
Periwinkle	*Vinca minor*	Ecological
Scotch broom	*Cytisus scoparius*	Ecological
Policeman's helmet (Himalayan balsam)	*Impatiens glandulifera*	Ecological
Goutweed (bishop's weed)	*Aegopodium podgaria*	Ecological
Saltmeadow cordgrass	*Spartina patens*	Ecological
Giant hogweed	*Heracleum mantegazzianum*	Ecological, human health, recreation

2.1 Key areas of concern

The District has identified key areas of concern that support the need for a comprehensive Invasive Plant Management Strategy (IPMS) including:

- In the absence of invasive plant policy, problems are dealt with inconsistently on a case by case basis. For example, there is no policy or guidelines on how to deal with invasive plants on private property. This is particularly challenging as there is a huge reservoir of invasive plants such as English ivy, lamium, periwinkle and knotweed growing on private lands, often crossing property boundaries.
- Treatment of invasive plants is not formally integrated into the development planning process. Developers are becoming increasingly aware of invasive plant issues, however more work is needed to formalize and communicate their responsibilities regarding invasive plant management and help provide solutions (Best Management Practices).
- Every year the Parks Department removes hundreds of tonnes of green waste from parks and natural areas which has been illegally dumped by residents and landscapers. Signage and informative letters sent to neighbouring residents have had no noticeable impact.
- Prior to this plan the District did not have a strategic plan for treating invasive plant species nor were Best Management Practices (BMPs) in place to direct appropriate treatment methods or preventative operational practices (including

Cherry laurel removal from a District park

[9] Forest Ecosystem Mapping and a Framework for Ecosystem-based Management for the District of North Vancouver. B.A. Blackwell and Associates Ltd. 2009

disposal and handling soil contaminated with invasive plants).

- Although most staff and departments participate in invasive plant related training, there is still a need for a coordinated approach to ensure all staff who encounter invasive plants or receive enquiries related to them are adequately educated.
- Staff regularly field questions from the community through phone calls, emails and direct contact on a variety of invasive plant related topics. Common enquiries relate to pesticide use, proper treatment and disposal methods, and challenges with plant spread from adjacent properties. Staff require readily available and audience appropriate resources to help them properly address questions and concerns.
- At a regional level, there is no protocol for the proper treatment, transport and disposal of soils contaminated with invasive plant material. Currently the District is using Inter River Park to store and monitor soil suspected of containing knotweed from District owned lands.

2.2 How has the District been managing invasive plant

2.3 s?

The District has been actively managing invasive plants on public land since 1998. This Strategy builds on a number of ongoing management initiatives including:

- Collaboration with other agencies (BC Ministry of Transportation, BC Hydro and First Nations) to treat large, shared knotweed infestations;
- Removal and containment of target knotweed species and giant hogweed by contract crews and staff on municipal lands since 2000;
- Removal of invasive plants and illegally dumped green waste on District maintained lands (e.g. landscape beds, road medians, trails, creeks, parkland, sport fields, mowed areas, etc.) for over 30 years;

Invasive plant removal by school children volunteers

- Participation at invasive plant courses, workshops and conferences;
- Coordination of volunteers and stewardship groups (e.g. North Shore Streamkeepers, North Shore Wetland Partners, NSMB, etc.) for invasive plant control and restoration projects in numerous parks throughout the District;
- Completion of a coarse scale invasive plant inventory as a component of the 2009 forest ecosystem mapping of District Parks[10]; and
- Involvement with the Invasive Species Council of Metro Vancouver since 2009, including participation in the development the Regional Invasive Species Strategy. Staff have twice held positions on the organization's Board of Directors.

[10] Forest Ecosystem Mapping and a Framework for Ecosystem-based Management for the District of North Vancouver. B.A. Blackwell and Associates Ltd. 2009

3 The Strategy: How will this strategy help?

The Strategy will provide a standardized approach to invasive plant management, ensuring efficient delivery of service. It will act as **a living document** that is updated continually through an adaptive management approach to implementation. The Action Plan for 2015-2020 (Action Plan 2015-2020) identifies implementation priority, phasing, relative costs and staff/departmental responsibilities.

The policy context for the Strategy is illustrated in Figure 1 and a summary of the supporting policy is provided in Appendix 1. The *Official Community Plan* (OCP) and Parks and Open Space Strategic Plan (POSSP) underpin the Strategy, bylaws and regulation enforce the Strategy and several key reports provide content and deliverables that have influenced the Strategy.

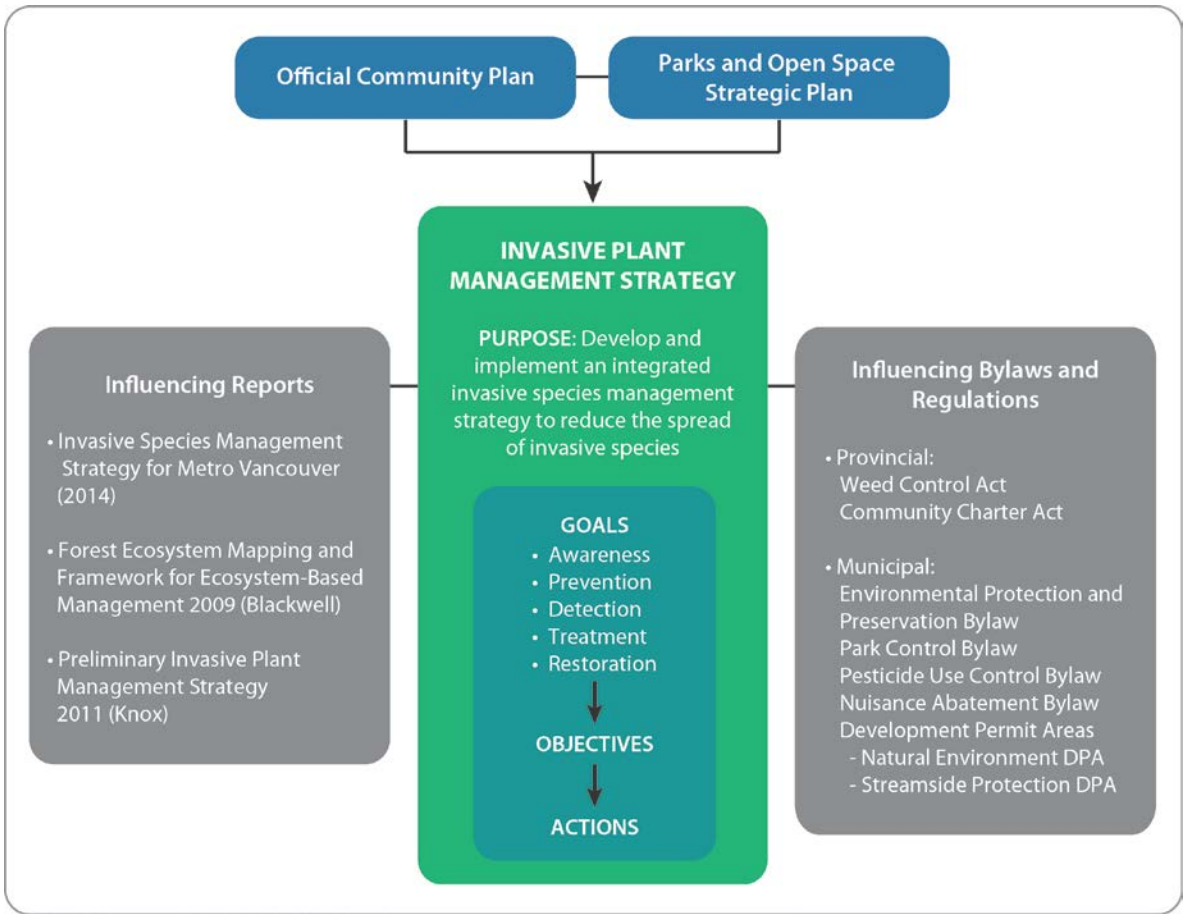


Figure 1. Invasive Plant Management Strategy: Context

This Strategy was initiated in 2014 to meet the recommendation from the District OCP, adopted by Council in 2011, to develop and implement an integrated invasive species management strategy to reduce the spread of invasive species. The Strategy also reflects Goal 5 of the POSSP, adopted in 2012 to "promote broad community stewardship of parks and open spaces to effectively conserve, protect and enhance ecological integrity and biodiversity" and is considered an important

component of future planning for climate change adaptation within the District since invasive plants can pose threats to native biodiversity.

This Strategy is focused solely on invasive plant species. Other invasive organisms (mammals, amphibians, birds, insects, parasites and disease, etc.) may be considered in the future.

Other Invasive Species in the District

American bullfrog (Royal BC Museum)

European fire ant (Dr. R. Higgins)

Invasive plants, the focus of this Strategy, are a subset of invasive organisms. There are many non-plant introduced species in BC, some of which are common in the District and are considered invasive based on their successful colonization[11]. The Eastern Grey Squirrel, Norway Rat, Black Rat and European Starling are a few easily recognized examples. Some species were intentionally introduced such as the American Bullfrog which was intended to be farmed in BC in the 1930s and 40s. It soon escaped and continues to spread in BC ponds and wetlands, displacing native frog populations[12]. The European Fire Ant is a recent invader first identified in BC in 2010. This ant is known for its tendency to rapidly swarm and sting when its nest is disturbed[13]. There have been several confirmed fire ant colonies within the District. The District is working with regional and provincial partners on how to best manage this species.

The District may consider strategies to manage newly arrived high risk invasive animal and insect species in the future.

3.1 Regional Context

This Strategy recognizes the importance of a collaborative regional effort to address the substantial risk posed by invasive plants. Invasive plants are not confined within political boundaries and their management requires cooperation by all municipalities and provincial agencies. Many jurisdictions have implemented invasive plant management strategies. On the North Shore, the City of North Vancouver (2013)[14] and the District of West Vancouver (2014) have developed formal plans to manage invasive plants. In 2014, the Invasive Species Council of Metro Vancouver (ISCMV), with the support of Metro Vancouver, member municipalities (including the District) and regional stakeholders, developed a regional strategy to help address cross jurisdictional challenges associated with invasive species management.

[11] Alien and Invasive Animal Species in British Columbia. E-Fauna BC. http://ibis.geog.ubc.ca/biodiversity/efauna/invasive_species.html

[12] BC Frogwatch Program. http://www.env.gov.bc.ca/wld/frogwatch/publications/factsheets/frogs/bullfrog.htm

[13] BC Inter-Ministry Invasive Species Working Group – European Fire Ants. http://www.for.gov.bc.ca/hra/invasive-species/fire_ants.htm

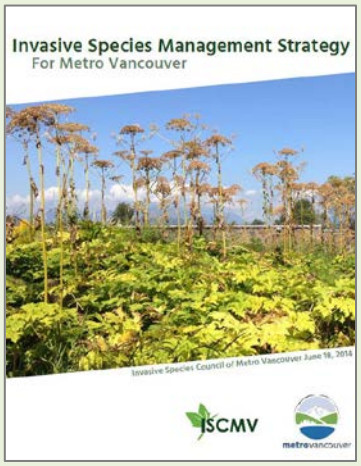
[14] City of North Vancouver. Invasive Plant Management Strategy. Retrieved April 4, 2014 from http://www.cnv.org/attach/2013%2007%2008%20item%2007.pdf

Regional: Invasive Species Management Strategy for Metro Vancouver

In 2014 the Invasive Species Council of Metro Vancouver developed a regional invasive species strategy in partnership and with the support of Metro Vancouver, its member municipalities (including the District of North Vancouver) and dozens of public and private stakeholders within the region. The purpose of the Strategy is:

> "To enhance the ability of local, provincial, federal and First Nations governments, working with homeowners, industry and environmental stewards, to prevent new invasive species from establishing in the region, and to contain and control established invasive species."

The Strategy has six goals which address the need for organizational structure and capacity, a consistent region-wide response to invasive species management, regional legislation, policy, monitoring, enforcement and education, a unified region-wide approach to communication (consistent messaging), a region-wide system for data collection, reporting and sharing of information, and ongoing monitoring of the Strategy's implementation.



A subset of action items in the Strategy are directed at local governments. The District is implementing every one of these actions. Some are already ongoing or have been done, for example, participating in ICSMV initiatives, collaborating with neighbouring jurisdictions, updating the Official Community Plan to ensure invasive species management issues are addressed, funding control and containment work, and encouraging and acknowledging the valuable contributions of stewardship groups. Other actions will be forthcoming with the implementation of the IPMS, for example, the formation an inter-departmental working group to coordinate invasive species management, prioritizing highly sensitive areas (e.g. spawning channels) for control and containment, requiring development sites where invasive species are present to be remediated and restored, amending bylaws to ensure that invasive species management issues are addressed and are consistent with regional standards.

In 2015 regional stakeholders (including municipalities) will have the opportunity to demonstrate their commitment and support for the Strategy by signing a Regional Invasive Species Management Charter.

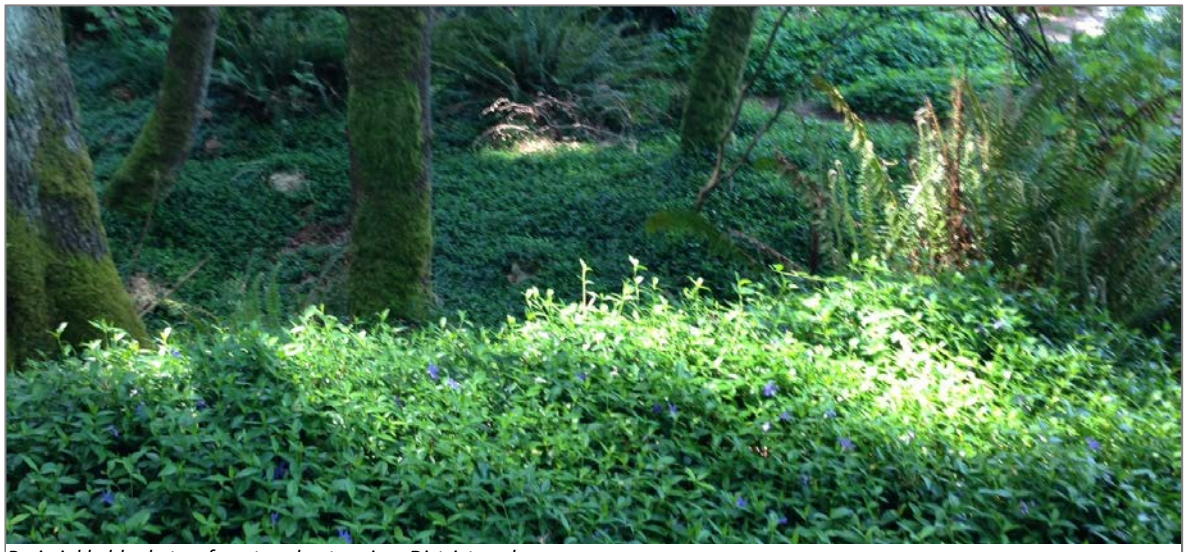
3.2 Regulatory Context

Invasive plants are regulated at the federal, provincial and municipal level (Table 2), however the effectiveness of these acts and bylaws is somewhat limited in urban areas. The B.C. Provincial *Weed Control Act* and *Community Charter Act* enable the District to manage the invasive plant problem through legislation and bylaws. The *Weed Control Act* is considered to be the key invasive plant legislation that offers municipalities the greatest ability to encourage and seek action of private property owners. However, the *Act* only applies to listed Noxious Weeds[15]. The Integrated Pest Management Act provides requirements related to pesticide use such as permits, licensing and conditions for use including signage.

The federal *Plant Protection Act* and *Seeds Act* restrict the entry of invasive plants into Canada. Appendix 1 provides an in-depth discussion of the regulatory context. Table 2. Summary of existing federal, provincial and municipal regulations related to invasive plant management.

[15] Noxious Weeds in the District: knotweed species, giant hogweed, purple loosestrife and yellow flag-iris.

Jurisdiction	Regulation/Bylaw	Relevance
Federal	*Plant Protection Act* S.C. 1990, c.22	Identifies a list of plants that are considered *Pests* in Canada. Regulates the distribution of these species.
	Seeds Act, R.S.C. 1985, c. S-8	Regulates the distribution of the seeds of species that are designated as *Prohibited Noxious Weeds*.
	Pest Control Products Act	Regulates pesticide registration and re-evaluation; human health and safety; environmental impact; and, compliance and enforcement through Health Canada (PMRA)
Provincial	*Integrated Pest Management Act*	*The IPMA provides detailed requirements related to specific types of pesticide use, revolving around licences, permits or pesticide use confirmations which must be obtained before pesticides can be used, and associated public notices and consultations.*
	Weed Control Act [RSBC 1996] CHAPTER 487	Identifies plants that are classified as noxious weed species in BC. Places a duty on all land owners to control these species. This does not apply to federal lands.
Municipal (DNV)	*Community Charter Act*	Authorizes municipalities to regulate invasive plants on private property through the use of bylaws. Regulatory powers depend on the threat posed (environmental, nuisance or public health concern).
	Environmental Protection and Preservation Bylaw No. 6515, 1993	Provides protection and preservation guidelines for aquatic areas, slopes, and soils. A permit is required for the removal or depositing of any soil.
	Park Control Bylaw No. 2733, 1961	Prohibits dumping of waste within parks. This bylaw is under review in 2014.
	Pesticide Use Control Bylaw No. 7686, 2009	Limits use of pesticides on residential properties. Permit must be obtained for pesticide use.
	- *Nuisance Abatement Bylaw* No. 7325, 2002	Requires property owners to keep property clear of noxious weed.
	Development Permit Areas (DPA) - Protection of the Natural Environment DPA Streamside Protection DPA	The DPA guidelines are in place to protect and improve the integrity, ecological health and biodiversity of natural features and systems. They outline the District's requirements for any proposed development within or adjacent to DPA lands. Invasive species management could be added to these guidelines.



Periwinkle blankets a forest understory in a District park

Goals and Principles
District staff have identified goals and principles that will guide the management of invasive plants, and direct future policy development and operational decision making. Opportunities for public input into these goals and principles will be provided in the future as a component of public consultation events related to the Strategy.

STRATEGY GOALS

Five key goals frame the District's strategic approach to invasive plant management:

1. AWARENESS: Communicate invasive plant management issues to staff, industry and the community.
2. PREVENTION: Prevent new invasive plants from establishing and spreading.
3. DETECTION: Detect invasive plants early and accurately.
4. TREATMENT: Control invasive plants safely and effectively.
5. RESTORATION: Restore natural habitat affected by invasive plants.

Part B of the Strategy addresses each of these goals. Within each goal, objectives are defined with associated actions to accomplish each objective**. Part C** provides an implementation plan and framework for adaptive management and measuring success.

GUIDING PRINCIPALS

1. Invasive plant management practices are science based and use an integrated pest management approach;
2. Management strategies seek to preserve, maintain and restore ecosystem health and protect natural resources, with a priority placed on protecting species and ecosystems at risk;
3. Public and staff safety, as well as the protection of infrastructure, are essential;
4. It is not possible or necessarily desirable to eradicate all invasive plants. A risk management approach will form the basis for setting priorities for operational activities in order to maximize the cost efficiency of efforts;
5. Management success requires cooperation and collaboration between staff, other municipalities and agencies, and the community through consistent, long-term programs;
6. Invasive plant management actions will focus on education, communication and operational practices. Regulatory enforcement will be pursued where appropriate;
7. Invasive plant management must address both public and private lands to be effective; and
8. An adaptive management approach is necessary to ensure informed decisions and updates to Best Management Practices can be made based on lessons learned within the District.

PART B: HOW SHOULD INVASIVE PLANTS BE MANAGED?

1 AWARENESS – Communicate invasive plant management issues to staff, industry and the community

1.1 Public Education

Objective: Devise and implement an invasive plant awareness campaign.

Of the total District land base, most is privately owned land where the District has limited ability to manage invasive plants. Public education and cooperation are therefore critical to reducing the spread of invasive plant species in the District. Communication with the public must raise awareness about the following:

- Prevention and control of invasive plant species that are priorities in the District (e.g. knotweed, giant hogweed, English ivy, lamium) because of risk to people, ecosystems and infrastructure.
- Illegal green waste dumping and improper disposal of invasive plant material that spreads invasive plants, impacts recreation access and draws on municipal funds for cleanup costs.

COMMUNICATION TACTICS

Below are several communications tactics which could be considered within a communication plan.

- Use community events as an opportunity to engage the community and display awareness campaign materials (e.g. Lynn Valley Days, Earth Day, voting days, community events etc.).
- Carry out a neighbourhood pilot project which combines a targeted education campaign with local park invasive plant control, removal of dumped green waste, community engagement and volunteer opportunities. Elements of this targeted neighbourhood approach could be carried forward into the future through inclusion within the District's Adopt-a-Street Program.
- Enhance signage in parks to complement the awareness campaign (See Appendix 3 for signage discussion).

Volunteers removing yellow flag-iris

ACTIONS:

1. Using other successful programs as models (e.g., City of Coquitlam's 'Bad Seed' Program, ISCMV's 'Knot on my Property' campaign) develop a communication plan for existing platforms (website, social media, print media, bus shelters etc.) with messaging that:
   a. Speaks to a wide audience (i.e. children, youth, and adults).
   b. Aims to change social norms and enhance understanding around invasive plant issues.
   c. Demonstrates how to take individual action.
   d. Offers opportunities for involvement in stewardship events.

1.2 Nursery & Landscape Industry

Objective: Educate the local nursery and landscape industry on how to prevent the introduction and spread of invasive plants.

Many invasive plant species originate as purchases from local nurseries. Local business sectors involved in the developing, planting or maintaining landscapes conduct substantial work on private lands in the District. To prevent invasive plants from being planted in private gardens and landscapes, awareness of the issue must be raised within this sector.

ACTIONS:

2. Collaborate with neighbouring municipalities, the ISCMV and local nurseries to develop a North Shore program that enables nurseries to advertise that they do not sell the invasive plant species listed in Table 16 and Table 17 and provide educational information (e.g. Grow Me Instead booklet[16]).
3. Educate landscapers and contractors of the risks posed by invasive plant species and discourage their use in landscaping through adherence to the BC Landscape Standard[17].

1.3 Internal Communication

Objective: Continue to strengthen internal communication between staff and departments managing invasive plants.

The District has been working to develop a consistent understanding of invasive plant species management between staff and departments. However, an agreed way of collaborative working for sharing information and coordinating invasive plant management activities has not yet been established.

ACTIONS:

4. Form an internal *Staff Invasive Plant Working Group* that meets regularly with representation from all departments involved in invasive plant management and control projects to set priorities, share information and resources, and coordinate activities.
5. Ensure that invasive plant management roles and responsibilities are clearly defined between both staff and departments (See Appendix 2 for summary of existing roles and responsibilities).
6. Ensure that all staff who deal with and encounter invasive plants continue to receive adequate and up-to-date training appropriate to their position and responsibilities. Ensure staff are aware of appropriate contacts within the *Staff Invasive Plant Working Group* with regard to specific issues they may encounter.
7. Familiarize District staff with the Invasive Plant Management Strategy focusing on its goals and objectives.

[16] ISCBC Grow Me Instead Booklet http://bcinvasives.ca/resources/publications/grow-me-instead-booklet

[17] BC Landscape Standards 2012. BC Society of Landscape Architects (BCLSA) and BC Landscape and Nursery Association (BCLNA).

2 PREVENTION – Prevent new invasive plants from establishing and spreading

2.1 Prevention BMPs

Objective: Apply best management practices (BMPs) for prevention of invasive plant spread on municipal lands.

Figure 2 illustrates invasion dynamics over time. There is only a small window of time after an invasive plant is first introduced where eradication may be possible before the plant spreads across a geographical area. Once invasive plants have established and are actively spreading, the cost of treatment increases exponentially and the likelihood of eradicating them decreases. In comparison, the cost of preventing their establishment is low.

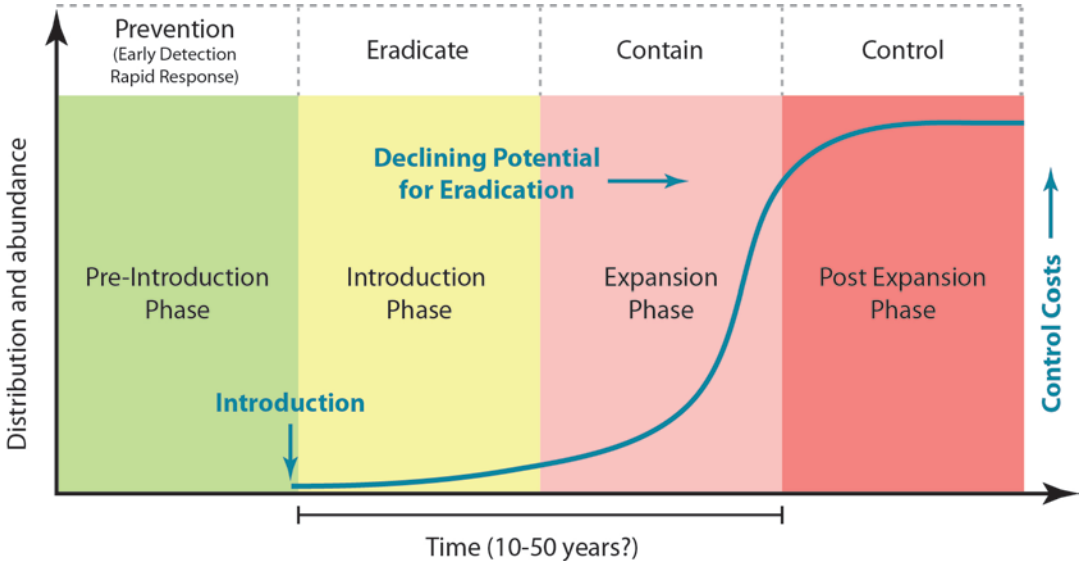


Figure 2. Invasive plant invasion phases and management strategies.

Prevention measures are the most cost effective and efficient avenue for the long term management of invasive plants. Preventative practices range from avoiding planting invasive plants to maintenance practices which reduce their spread. Both the BC Landscape Standards [18] and Best Practices Guides[19] produced by the Invasive Species Council of BC (ISCBC) document preventative practices which can be employed in a variety of situations (see also Appendix 6). Proper disposal of invasive plant material is also a key practice to reduce the risk of further spread (see species specific BMPs in Appendix 6 for disposal guidelines).

[18] BC Landscape Standards 2012. BC Society of Landscape Architects (BCLSA) and BC Landscape and Nursery Association (BCLNA).
[19] http://bcinvasives.ca/resources/publications/

ACTIONS:

8. Continue to work with the BCLNA and BCSLA on establishing invasive plant prevention practices and standards.
9. Adopt Best Management Practices for preventative techniques to reduce the risk of invasive plant establishment and spread (Appendix 6).

2.2 Green Waste Dumping

Objective: Prevent green waste dumping and park encroachment by landscape contractors and residents.

Illegal dumping of green waste (e.g. garden clippings, discarded plants, etc.) in natural areas is one of the most common sources of invasive plant establishment. Residents and landscape contractors are most often responsible for this practice. Occasionally residents expand back yards into park natural areas, clearing native vegetation in the process and often introducing invasive plants.

THE COST OF GREEN WASTE DUMPING

Lamium spreading from dumped green waste

Cleaning up dumped green waste and preventing park encroachment to protect District natural areas incurs high annual costs to the District. In 2014 from June to October, the District's park crews removed 187 tonnes of invasive plant material from parks at a cost of $58,000. One third of this was illegally dumped debris and green waste. This work targeted 11 sites where invasive plants and dumped debris were either blocking recreation access or creating a safety concern. These 11 sites represent an extremely small fraction of the amount of dumped waste in District parks. It is estimated that less than 5% of illegal dump sites have been cleaned up to date. Besides the cost incurred by the District, illegal dumping has social costs, potentially impacting neighbour relations and the aesthetic value of a neighbourhood. Invasive plants from illegal dumping spread not only into parkland but also into adjacent private homeowners' properties, potentially incurring cost to them for control and removal.

ACTIONS:

10. Amend the Park Control Bylaw to include the prohibition of dumping invasive plant material. Enhance compliance and enforcement by increasing the fine for infractions and allowing staff who deal with illegal dumping to issue "Order to Comply" notices.
11. Educate residents about the Park Control Bylaw, consequences, cost of green waste dumping and park encroachment through the proposed Invasive Plant Awareness Campaign, and encourage the use of alternatives for disposal (i.e. green waste pickup). See species specific BMPs in Appendix 6 for disposal guidelines.
12. Educate landscapers and contractors about the Park Control Bylaw, consequences and cost of green waste dumping and park encroachment through the business permit process.

2.3 Soil

Objective: Prevent the movement and improper disposal of soil contaminated with invasive plants.

Invasive plants are often dispersed through the movement of soil, rock, and fill which is contaminated with whole plants, root or stem fragments, or seeds. Knotweed can establish from very small root or plant fragments. Many knotweed infestations are thought to have established from contaminated soils used for road fill or landscaping[20].

Soil movement of invasive plants is particularly a problem for development sites because of soil mixing and transport. The District's Environmental Protection and Preservation Bylaw, which requires a permit to move soil from a site does not explicitly address soils contaminated with invasive plants.

Knotweed growing in a back alley

There is currently no regulated means to dispose of soil contaminated with invasive plants at either the municipal or regional level. The District initially used Inter River Park to store and contain soil contaminated with knotweed. However there is a limit to the amount of material the site can accommodate. This option is not available to private land owners and there is concern that invasive plants will be transported and spread around the region.

ACTIONS:

13. Assess whether develop new soil bylaw is warranted or if amending the District's Environmental Protection and Preservation Bylaw to include the management of soils contaminated by invasive plants is sufficient to address the problem.
14. Incorporate specifications for contaminated soil management in the District's master list specification. Update corporate policy to ensure that developers are aware of this requirement. Include this in the environmental review for developers. A Qualified Environmental Professional (QEP) would be required to ensure that soils are free of invasive plant species prior to issuance of a soil permit.
15. Develop internal and external BMP factsheets to guide soil management and disposal. Until a regional solution is developed the best practice for knotweed contaminated soil is to adequately treat the infestation prior to soil movement and to keep contaminated soil on site, contained in one location and monitored for the long-term.
16. Work with neighbouring municipalities and regional government to develop soil transfer and disposal regulations and adopt regional "invasive free" certification for soil and mulch products. Encourage regional coordination of provincial direction on this issue.

[20] There is increasing evidence from research carried out at the University of the Fraser Valley (under direction of Dr. Sharon Gillies) that many knotweed infestations in the Lower Mainland are sexually reproducing Bohemian knotweed (producing viable seed). This is in opposition to earlier assumptions that most knotweed in the region was Japanese knotweed which spreads only vegetatively. This may lead to changes in management practices for knotweed once more information is known.

3 DETECTION – Detect invasive plants early and accurately

3.1 Early Detection

Objective: Implement an Early Detection and Rapid Response (EDRR) system.

Once introduced, the most effective and efficient control of invasive plants is to treat when still in the introduction phase (Figure 2) by using an approach called "Early Detection and Rapid Response (EDRR)". The cost of EDRR is miniscule compared to the cost of controlling an invasive plant that has established and spread. The province has an EDRR Plan which outlines how new invasive plant incursions that are of risk to BC can be quickly and effectively addressed[21].

There are invasive plant species which have already established in other parts of BC, Metro Vancouver and even the North Shore but have not yet been detected in the District (e.g. gorse in Horseshoe Bay). Early detection of these species requires a co-ordinated rapid response both within the District and with other levels of government.

EARLY DETECTION RAPID RESPONSE: CASE STUDY

Common reed (*Phragmites australis subsp. australis*) is a regulated provincial noxious weed under the BC *Weed Control Act*. It is a tall plant (2.5-5m) that grows rapidly in wetlands forming dense stands. In 2011 treatment of the plant in high priority sites was initiated as part on the provincial Invasive Plant Early Detection Rapid Response Program[22]. The plant was detected in a roadside ditch in Richmond in 2010. A treatment plan was quickly drawn up and the plant was treated with herbicide in 2011. The site continues to be monitored. To date only minor re-growth has occurred and no new patches have been detected in Richmond. This is an example of how quick response led to prompt treatment of a new invader, preventing spread and averting the need for a costly control program.

Typical height of common reed

ACTIONS

17. Formalize an EDRR protocol. Specifically:
    a. Designate the responsibilities of District EDRR to a staff position to respond to reports (from staff and the public) of new arrivals to confirm species identification, map their location and arrange appropriate treatment (District land) or inform the landowner.
    b. Maintain a 'watch list' of plants likely to be invasive in the District and communicate updates to the proposed *Invasive Plant Working Group* (see the current Watch List in Appendix 5).
    c. Communicate with agencies who host provincial and regional public reporting mechanisms to ensure that sightings reported within the District get addressed in a timely manner (e.g., the Provincial Invasive Alien Plant Program 'Report-a-Weed' tool, the Royal BC Museum's 'Aliens Among Us' website, and sightings reported directly to the ISCMV).
    d. Report occurrences of provincial EDRR species to the Provincial EDRR coordinator.

[21] Invasive Plant Early Detection and Rapid Response Plan for British Columbia. 2012. http://www.for.gov.bc.ca/hra/invasive-species/Publications/EDRR_Plan_Final_Draft_Nov2012.pdf

[22] Ministry of Forests, Lands and Natural Resource Operations. 2011. *Phragmites australis subsp. Australis* Stakeholder Response Reference

3.2 Inventory

Objective: Develop and maintain an invasive plant inventory on District owned land.

Spatial data on plant abundance and distribution provides the information required to make informed decisions regarding invasive plant management. The data can be used to identify problematic locations for invasive plant introduction, prioritize treatments, direct operations and track change over time to measure success.

The District currently has four sources of inventory data. All offer some degree of value but none provide a stand-alone, complete inventory of the entire District-owned land base. Appendix 4. identifies these datasets and summaries the value and deficiencies of each. It should also be recognized that District staff involved in invasive plant management offer a wealth of inventory knowledge gleaned from their work on the ground. Over time or with staff changes this information can easily be lost or forgotten if not properly documented.

Scotch broom

Until recently, there was no unified District platform for exchanging spatial information and tracking invasive plant data over time other than the Ministry of Forests Invasive Alien Plant Program (IAPP). In 2014, the District initiated an invasive species mapping tool (a GeoTool) within the District's internal GIS system, GEOweb. The benefits of using the GeoTool rather than IAPP are discussed in Appendix 4.

Building a consistent and comprehensive inventory using the District's invasive plant mapping tool will provide the following advantages:

- Inventory collection can be completed by staff or contractors in the field using hand held tablets that can upload information directly to GEOweb.
- Spatial data collected is standardised and includes information on species, location and abundance (area, density), and can be linked to treatment records;
- Staff will be able to analyze abundance and dispersal patterns, which can be used to determine containment lines for high risk species, monitor treatment efficacy, and measure progress towards treatment goals;
- Data collected will be consistent with the information required by the Provincial Invasive Alien Plant Program (IAPP), and permit batch upload to IAPP to facilitate information sharing should IAPP develop such a function in the future;
- Staff will be able to more accurately determine the phase of invasion of specific species. This will allow more confidence when deciding on the appropriate management strategy (i.e. eradicate, contain, control); and
- Data will be accessible to staff and departments and easily shared with other agencies and neighbouring municipalities.

ACTIONS:

18. Transition existing inventory into, and store future inventory data within, the District's invasive plant mapping tool (transition process described in Appendix 4).
19. Train and equip all staff that manage invasive plants in the field on the use of the invasive plant mapping tool (to maintain and augment the inventory).
20. Undertake a complete, up-to-date spatial inventory of invasive plants. A phased approach is described in Appendix 4. The inventory will provide the following information:
    a. A measure of abundance and distribution pattern;
    b. A record of treatment either recommended or completed;
    c. An understanding of budget requirements for treatment; and
    d. Monitoring results of infestation response following treatment.

4 Treatment – Control invasive plants strategically and effectively

Eradication or even control of all invasive plants District wide is not practical for several reasons:

- Many species are well established and there are insufficient resources available to control them. In some cases, the cost outweighs the benefit to be gained by controlling invasive plant species[23].
- There is a vast reserve of seed sources on public and private lands (i.e. English holly, cherry laurel, blackberry, English ivy) both within the District and beyond in neighbouring jurisdictions. Some of these species should only be controlled in cases where specific assets need protection (e.g. species and ecosystems at risk, infrastructure, etc.), since continued spread of seed by birds is inevitable.
- The impacts caused by clearing large swaths of invasive plants can outweigh the benefits of attempting full scale restoration in some situations.

Resources for invasive plant control are limited and must be used effectively. **Figure 3 provides an overview of a strategic approach to invasive plant treatment in the District.** Two decision making tools have been devised to guide treatment priorities: Species Priority and Park Land Priority. These tools will help the District define the scope of projects within their invasive plant treatment program. An Integrated Pest Management Approach and current best management practices then inform treatment options for each individual treatment project.

Community volunteers show the pile of invasive plants they removed from a District park

[23] Yokomizo et al. 2009. Managing the impact of invasive species: the value of knowing the density-impact curve. Ecological Applications, 19 (2) pp. 376-386

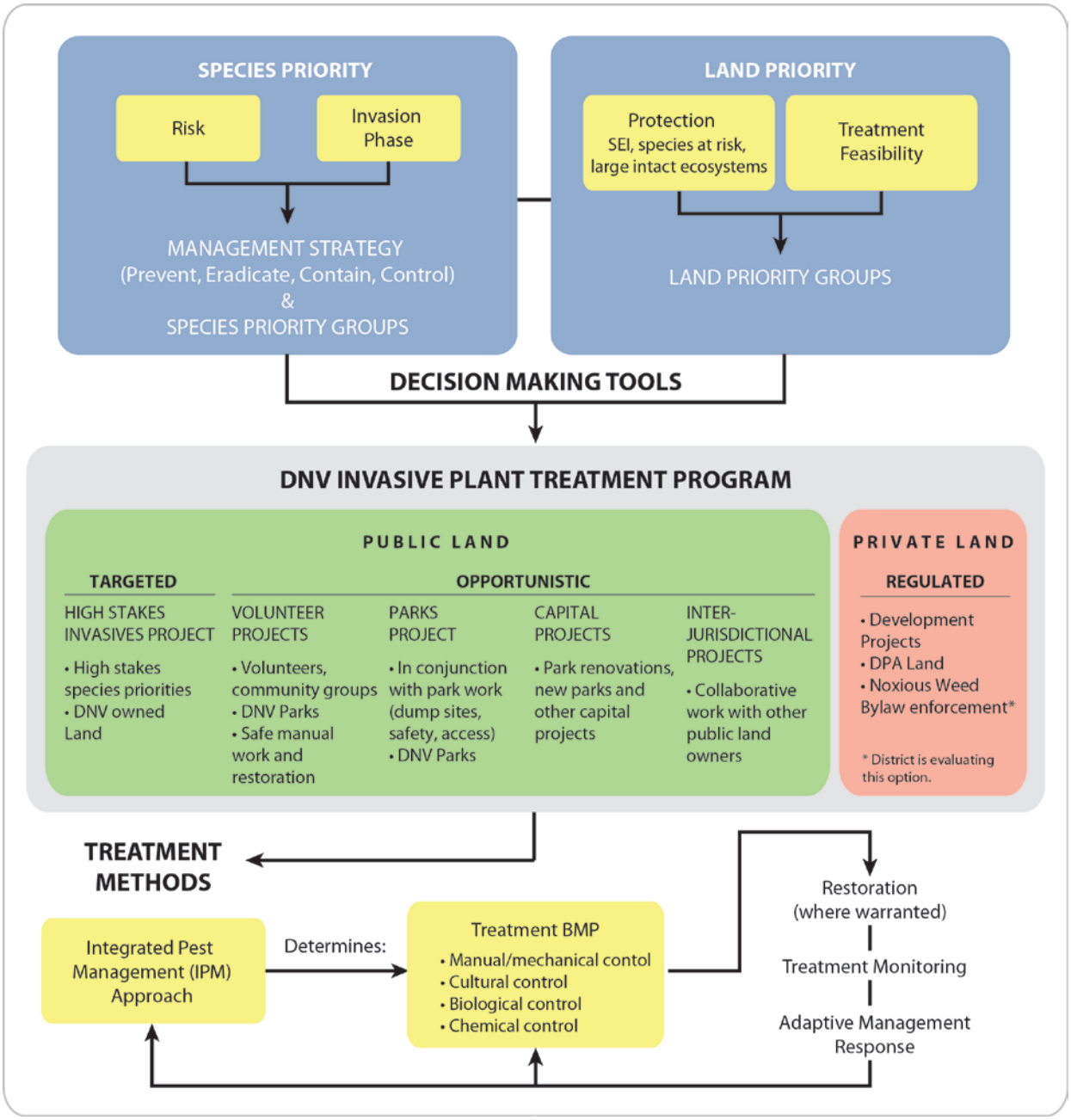


Figure 3. Treatment overview diagram.

4.1 Treatment Priorities

Objective: Set treatment priorities by evaluating species risk and treatment feasibility.

4.1.1 Species Priority

There are over 50 invasive plant species known to occur in the District. Some are garden variety weed species that are a nuisance to gardeners but do not pose any serious risks. Others are more problematic and pose significant risks to human health, infrastructure or the District's native ecosystems.

In order to determine priorities and management strategies, invasive plant species known to occur in the District have been assessed based on risk and estimated invasion phase. The risk assessment is explained in Appendix 5. The invasion phase of each species has been estimated based on limited available inventory data[24]. Each invasion phase corresponds to a management strategy (Figure 2 and Table 3).

English holly

Table 3. Management strategies based on invasion phase.

INVASION PHASE	MANAGEMENT STRATEGY
Pre-Introduction	Species has not arrived in the District and can be **PREVENTED** from establishing. Management should aim to keep invasive plants from establishing. They may be present in surrounding jurisdictions such as Washington State or the Fraser Valley, or are able to grow in similar environments and latitudes. Awareness and prevention actions are key at this phase.
Introduction	Species occurs at relatively low levels of infestation. Isolated populations consist mainly of individual plants. **ERADICATION** at this stage is usually feasible. Management should aim to target emergent invasive plants with small numbers of localized populations. With early detection and rapid response (EDRR) it may be possible to get rid of the species within the District in a short time frame.
Expansion	Plants begin to spread and disperse over short distances. Eradication is more difficult, but it is feasible to **CONTAIN** infestations and prevent further spread. Management should aim to contain plants that are widespread in the District often in isolated sites. The goal is to contain these plants to stop their spread.
Post Expansion	A species disperses over long distances and becomes abundant across the landscape. At this stage it is only feasible to **CONTROL** the species at specific sites to reduce their impacts. Management should aim to control plants that are widespread in the District with little chance of containment. These plants are only worked on in specific sites where there is a need to protect a resource.

[24] Due to limits of existing inventory data, it is possible that the wrong invasion phase has been attributed to some invasive plant species. As a more comprehensive inventory is developed, the invasion phase of each species can be attributed with a greater degree of confidence.

Figure 4 provides an evaluation matrix combining risk and invasion phase to determine Species Priority.

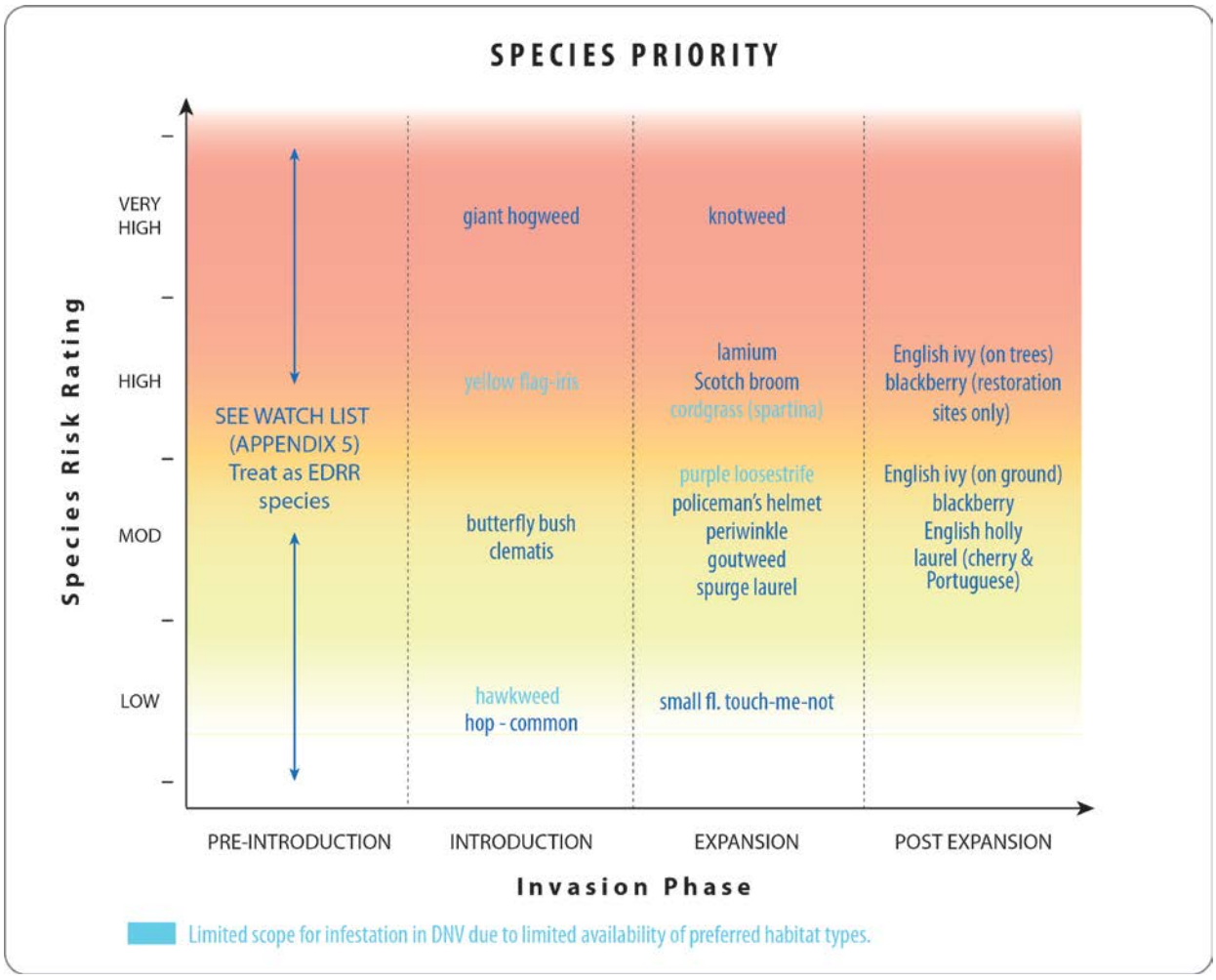


Figure 4. Species Priority.

Three treatment groups have been identified based on their risk, invasion phase and jurisdictional limitations. The treatment approach for each group is summarized in Table 4.

Table 4. Treatment approach by species group.

TREATMENT GROUP:	Treatment Approach	Species	Treatment Strategy Details
High Stakes	High risk species: **top priority for control.** Direct budget to be allocated for High Stakes treatment projects (see section 8.2) These species can also be controlled opportunistically where appropriate and safe to do so.	Giant hogweed	ERADICATE: Treat and monitor on all District land. ● Prioritize high use areas, trails and park edges. ● Request treatment by land owners of infestations on private property.
		Yellow flag-iris	ERADICATE: Monitor all ponds and wetlands on District land. ● Treat if infestation is small and damage to riparian shoreline can be avoided.
		Purple loosestrife[25]	ERADICATE: Monitor all ponds and wetlands on District land. ● Treat if infestation is small and damage to riparian shoreline can be avoided.
		Knotweed species	CONTAIN: ● Treat all infestations occurring outside of park natural areas (e.g. road allowances, boulevards, mowed areas, landscaped areas, etc). ● Begin systematic treatment of park natural area from the top end of riparian corridors and moving downstream. Prioritize sensitive ecosystems[26]. ● Collaborate on treatment projects with other public land owners (e.g. BC Hydro, City of North Vancouver, Tsleil Waututh Nation, Port of Metro Vancouver, etc.)
		Lamium (yellow archangel)	CONTAIN: ● Treat small patches only (<5m^2) in sensitive ecosystems. ● Treat small, new infestations in parks otherwise void of lamium.
		Scotch broom	CONTAIN: Treat in sensitive ecosystems (e.g. dry rock outcrops, foreshore) or where deemed to be a fire hazard
		English ivy (climbing trees)	CONTROL: Treat ivy climbing trees (clipping at base and pulling back from tree stem) to preserve the tree canopy.
		Blackberry (restoration sites)	CONTROL: Treat aggressively on restoration sites to ensure native vegetation successfully establishes
Incidental	Moderate to low risk species. **Controlled opportunistically** in conjunction with park operations, at high priority sites or to protect managed assets.	Butterfly bush	ERADICATE: Priority 1 for opportunistic treatment.
		Clematis - old man's beard	
		Hops	
		Periwinkle	CONTAIN: Priority 2 for opportunistic treatment.
		Policeman's helmet (Himalayan balsam	

[25] Recent observations indicate that purple loosestrife may not be as invasive or as ecologically detrimental on the BC South Coast as once thought. Review the plant's risk rating if new research confirms these observations.
[26] For the purposes of the IPMS, sensitive ecosystems are defined as these SEI categories (from the Forest Ecosystem Management Report): riparian, pond, cliff, red listed species.

TREATMENT GROUP:	Treatment Approach	Species	Treatment Strategy Details
		Goutweed (bishop's weed)	
		Spurge (daphne) laurel	
		Small flowered touch-me-not (star balsam)	
		English ivy	CONTROL: Priority 3 for opportunistic treatment. Becomes priority 1 in cases of safety or access concerns.
		Blackberry	
		Laurel (cherry & Portuguese)	
		English holly	
Inter-jurisdictional	Species of regional concern but minimal concern to the District. **Cooperate with regional efforts where appropriate**.	Spartina (cordgrass)	CONTAIN: Maintain contact with the BC Spartina Working Group who are monitoring the Park Drive and Maplewood Flats occurrences[27] (population thought to be stable as of last 2012 assessment)
		Hawkweed – orange	ERADICATE: Maintain contact with the ISCMV who are monitoring the emergence of hawkweed regionally and carrying out control efforts on ski runs in Cypress Provincial Park.

4.1.2 Park Land Priority

In absence of a comprehensive inventory of invasive plant species on District lands, the Park Land Priority was developed to help prioritize efforts on park land for inventory, treatment and restoration work. It is based on two premises:

1. PROTECTION - Prioritizing the protection of elements at risk: sensitive ecosystems, red listed species[28] and large intact natural areas (North Shore contiguous forest, foreshore of Burrard Inlet).

2. FEASIBILITY - Prioritizing the treatment of the least degraded ecosystems, focusing on areas with minimal invasive plant infestations increases treatment feasibility; a greater amount of land can be protected with limited available resources. Conversely, if resources are focused into highly degraded ecosystems, far less area will be treated and the likelihood of long-term success is reduced.

The outcome of the Park Land Priority is shown in Figure 5. In the absence of other park management priorities (e.g. safety, access, beautification, etc.), the Park Land Priority can be used to help direct treatment efforts. Sensitive ecosystems (shown in Figure 5) and ecosystem degradation (Figure 6) provide additional complimentary information.

[27] BC Spartina Working Group. http://www.cmnbc.ca/atlas_gallery/invasive-species-spartinaca

[28] For the purposes of the IPMS, sensitive ecosystems are defined as these SEI categories (from the Forest Ecosystem Management Report): riparian, pond, cliff, red listed species.

How to use this information to choose sites for invasive plant species control and restoration:

1. Establish presumed 'invasive plant free zones[29]' to reduce the area of concern in Park Priority Group 1.
    - Large tracks of land within the contiguous forest of the North Shore mountains can be presumed to be free of invasive plants if greater than 15 m away from access roads and trails, and 30 m away from the urban interface boundary. This assumption can be applied to District park land not classified in Figure 6 (i.e. outside of the 2009 Forest Ecosystem Mapping boundary).
    - Within Park Priority Group 1, for area classified as 'Low' in Figure 6, invasive free status can be implied once an inventory has been carried out of all sensitive ecosystems and within 15 m of access roads and trails and within 30 m from the park perimeter adjacent urban interface.

Policeman's helmet (Himalayan balsam)

2. Establish monitored 'invasive plant free zones' to account for known sites which are free of invasive plants.
    - Historic invasive control and restoration sites which are now being monitored.
    - Sites or park parcels which the staff know to be invasive plant free.

Lamium carpeting a streambank

3. Within the remaining park area (outside in invasive plant free zones) follow the Park Priority Group order to delineate control and restoration sites as follows:
    - Prioritize sensitive ecosystems (Figure 5).
    - Pursue areas classified as 'Low' first, then 'Moderate' in Figure 6.
    - Employ these containment strategies:
        i. Focus on the least disturbed area first
        ii. Focus on small isolated patches before large patches
        iii. Start upstream and work downstream to prevent source populations from spreading downstream
        iv. Start at the outer edge of an infestation and work inward
        v. Focus of patches that threaten important areas nearby with no infestation.
        vi. Consider source of infestation and mode of spread: if re-infestation is probable, address that issue before using resources on treatment.

[29] Invasive plant free status does not include being free of English holly.

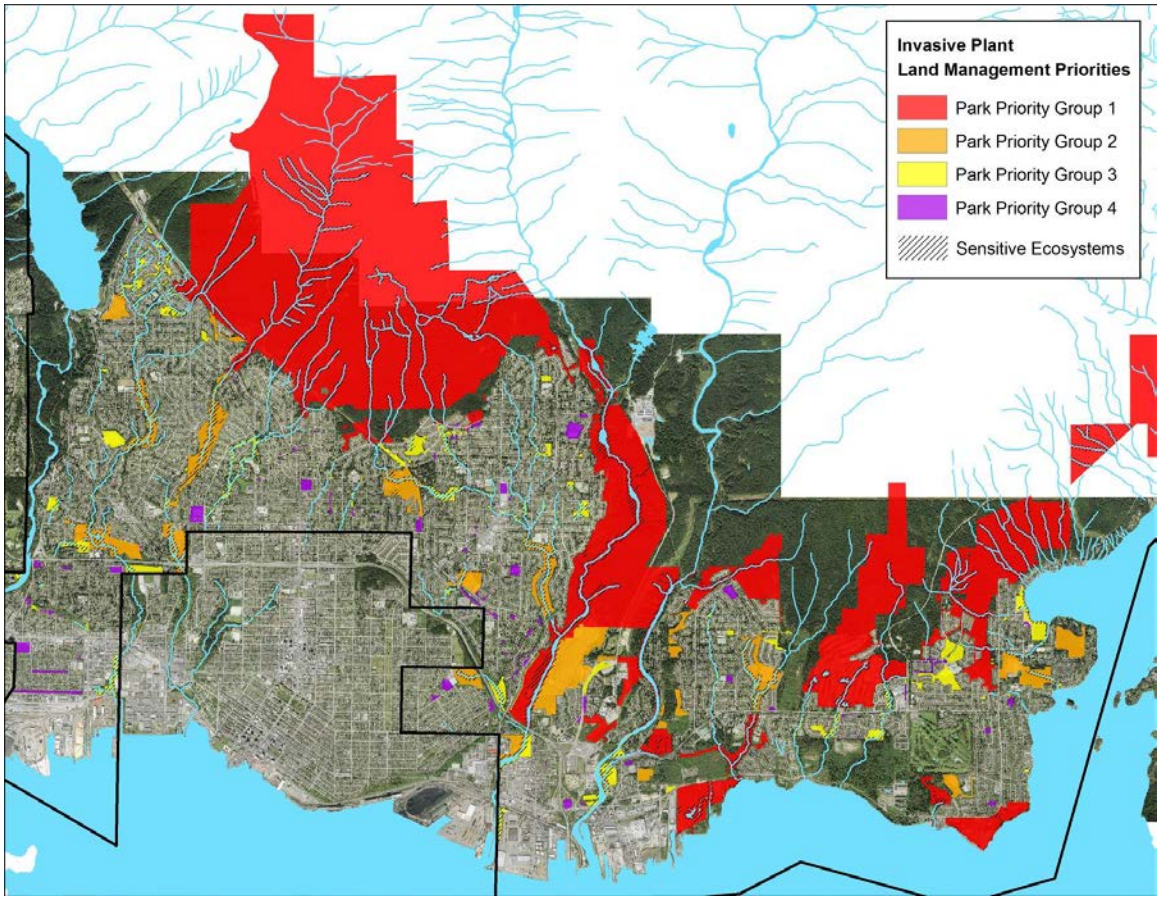


Figure 5. Park Land Priority Groups.

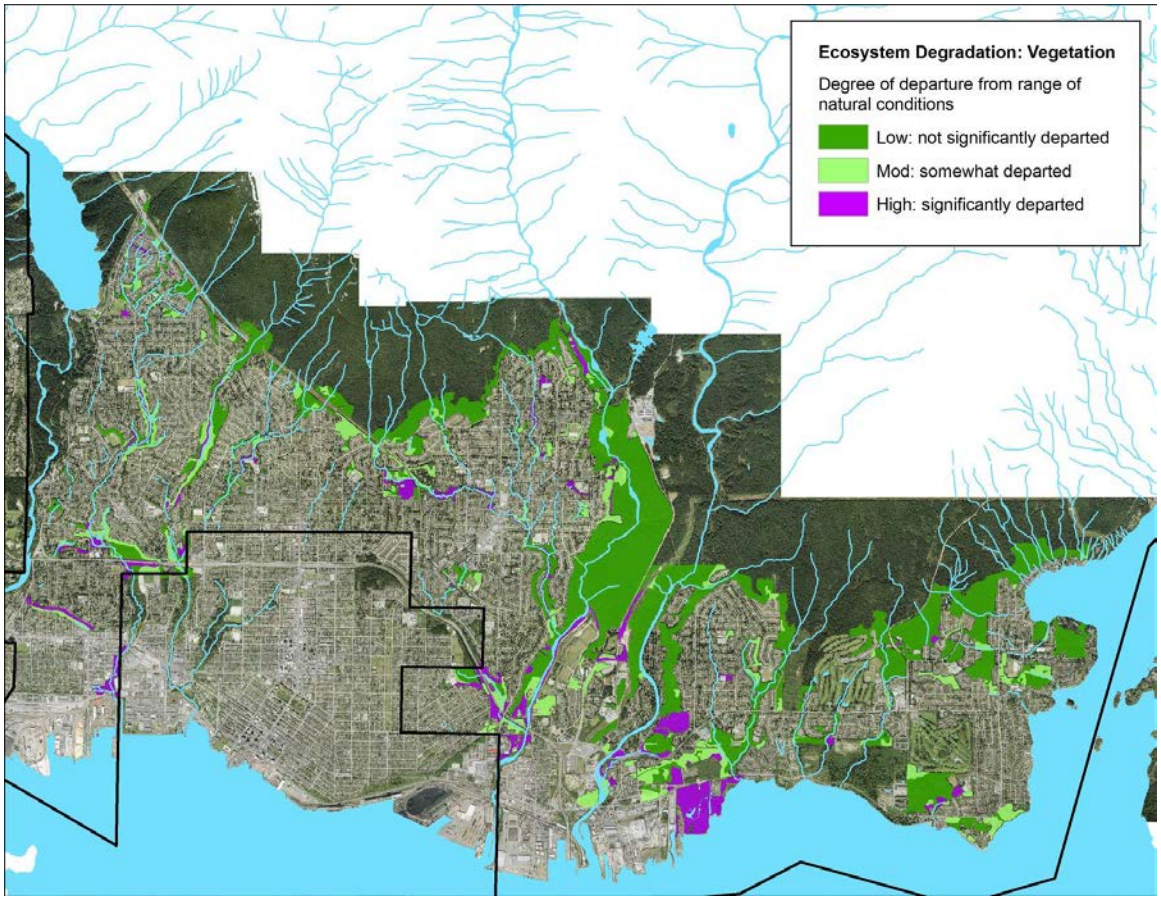


Figure 6. Ecosystem degradation of vegetation: degree of departure from natural range of conditions[30].

ACTIONS:
21. Use the Species Priority and Park Land Priority as decision tools to guide treatment priorities.

4.2 Treatment Program

Objective: Implement a strategic District wide invasive plant control program.

The District's invasive plant treatment program is composed of targeted and opportunistic projects on public land as well as regulated treatment on private land (Figure 7).

[30] Forest Ecosystem Mapping and a Framework for Ecosystem-based Management for the District of North Vancouver. B.A. Blackwell and Associates Ltd. 2009

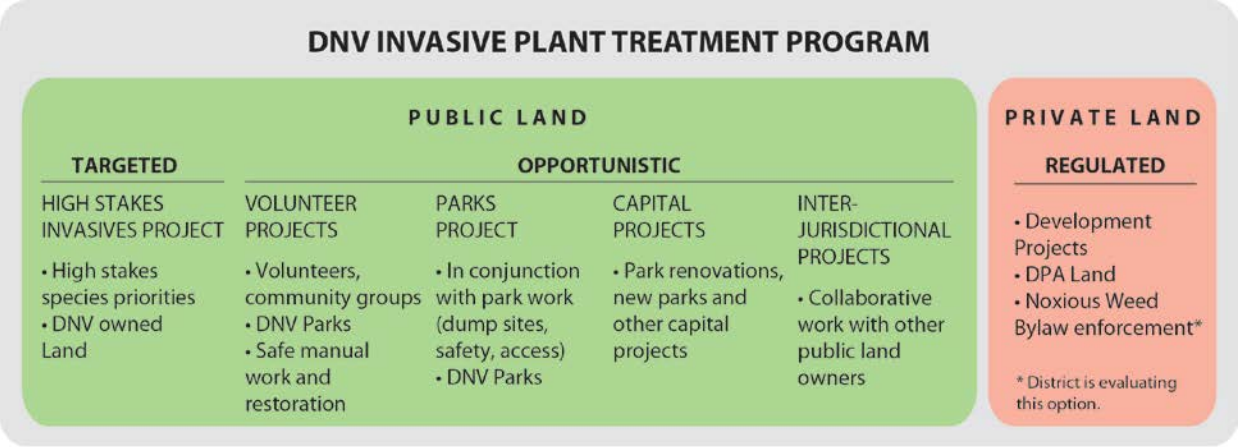


Figure 7. Overview of the components of the District's Invasive Plant Treatment Program.

HIGH STAKES INVASIVES PROJECT

Scope: Target species in the High Stakes priority group
Priority Guidance: Species Priority Evaluation
Staff Coordinator: Field Arborist
Personnel: Coordinator, contractors, parks staff
Treatment Method: Manual and chemical

VOLUNTEER PROJECTS

Scope: All projects undertaken by volunteers
Priority Guidance: Land Priority Evaluation: build on past projects; use land priority group to find new project sites
Staff Coordinator: Trail and Habitat Coordinator
Personnel: Coordinator, volunteers, stewardship groups
Treatment Method: Manual

Each year stewardship groups and other community volunteers participate in 30 to 50 invasive plant removal events. District Parks staff determine suitable sites and supervise the volunteers. All invasive plant removals are done manually by hand. Where appropriate, sites are replanted with native species. The sites are monitored and re-growth treated as needed. Records are kept of all events including number of participants.

There are several dozen groups who are regularly involved in invasive plant removal projects in the District. These include environmental organizations (e.g. North Shore Streamkeepers, North Shore Wetland Partners, Save Our Shores, BCIT Estuary Program, etc.), recreation groups (NSMB), neighbourhood groups, community associations, and school groups. Some groups, such as Friends of Hunter Park and the MacKay Creek group adopt specific parks and carryout multiple efforts each year. Volunteer events provide the community with opportunities to make a difference in their own back yard, become more informed and aware of the issues and spread the word to the community at large.

The work carried out by volunteers is invaluable, particularly since District resources for invasive plant treatment are finite.

Coordination by District staff is key to the success of volunteer projects. Staff must assess the abilities of each group and find appropriate project sites. Often staff must teach volunteers how to safety and effectively carryout the work, supervise the event, and ensure BMPs are followed. Occasionally groups plan their own stewardship events. A permitting system would provide a way to communication important information to groups (e.g. safety and liability issues, staff contact), maintain records of work carried out, and provide staff more control over where work is taking place.

PARK PROJECTS

Scope:	Projects undertaken by Parks crews in conjunction with operational work
Priority Guidance:	Species and Land Priority Evaluation should be a consideration in operational work plans
Staff Coordinator:	Horticulture Supervisor
Personnel:	Parks operational staff
Treatment Method:	Manual

CAPITAL PROJECTS

Scope:	Projects undertaken in conjunction with capital projects
Priority Guidance:	Species and Land Priority Evaluation should be a consideration in capital project work plans
Staff Coordinator:	Parks Manager
Personnel:	Parks operational staff
Treatment Method:	Manual and chemical

INTER-JURISDICTIONAL PROJECTS

Scope:	Collaborative work with other public land owners
Priority Guidance:	Species and Land Priority Evaluation may be useful for District-directed inter-jurisdictional work. However, project priorities may be set by other jurisdictions in some cases.
Staff Coordinator:	Field Arborist
Personnel:	Coordinator, contractors, parks staff, personnel from other jurisdictions
Treatment Method:	Manual and chemical

The District sometimes works collaboratively on projects with other public land owners. Potential collaborators are: City of North Vancouver, District of West Vancouver, Metro Vancouver, BC Parks, the Tsleil-Waututh Nation, Port of Metro Vancouver, BC Hydro, CN Rail, Canadian Food Inspection Agency, and Invasive Species Council of Metro Vancouver.

DEVELOPMENT PROJECTS

Scope:	Projects undertaken in coordination with development projects on private property
Staff Coordinator:	Environment staff
Treatment Method:	Manual and chemical

For further discussion on other types of invasive plant management on private land, refer to Section 4.4 Private Land.

MONITORING PROGRAMS

Monitoring programs are critical to measure the success of treatment programs. Monitoring for several years may be required to ensure control methods are effective and restoration plantings are successful. Monitoring will also help identify unforeseen responses to the control method and therefore must be conducted with adaptive management in mind. Adaptive management is especially important during the initial stages of the Strategy's implementation when control and restoration methods are being tested.

Example Treatment Monitoring Protocol

The list below encompasses information that could be recorded as part of a treatment monitoring program. The list is not exhaustive nor do all components necessarily need to be recorded in every situation.

- Treatment: date, person in charge, species targets, method, area treated, volume removed, establish photo plots prior to treatment, cost
- Restoration: date, person in charge, plant species, quantities, spacing, site prep (silt fence, mulch, geo textile, etc.), cost
- Maintenance: date, person in charge, species targets, method, area treated, volume removed, survival rate, cost

ACTIONS

22. Develop an annual work plan and budget for each invasive plant control project. Each project should have a staff coordinator who acts as the contact person and is a member of the *Staff Invasive Plant Working Committee*. This coordinator is also responsible for ensuring all treatment sites are recorded in GeoWeb using the invasive plant mapping tool and ensuring proper monitoring records are kept for all treatment projects.
23. Require that community groups who wish to carryout invasive plant control work apply for a permit which is reviewed by a staff coordinator. House this permit within the Parks Control Bylaw.

4.3 Treatment BMPs

Objective: Apply best management practices in all invasive plant control.

An overview of the components of invasive plant treatment is shown in Figure 8. Integrated Pest Management is used as a framework to guide control and management of any type of 'pest', including invasive plants. IPM is used by managers of both large (e.g. provincial crown land) and small (e.g. plant nurseries) land bases. The ***Provincial Pest Management Plan (PMP) for the South Mainland Coast***[31] guides the protocols and approaches to invasive plant management and treatment in the region. This

[31] BC Ministry of Environment. Pest Management Plan for Invasive Alien Plant and Noxious Weed Control on Provincial Crown Lands within the South Coastal Mainland of British Columbia. Retrieved Aug 2, 2013, from http://gov.bc.ca

PMP offers a relevant model for the District's own IPM procedures. In the case of pesticide use on public land, the provincial *Integrated Pest Management Act and Regulation* require the use of Integrated Pest Management.

The IPM approach guides the type of treatment used to control an invasive plant. There are generally four categories of treatment options for invasive plants: mechanical, cultural, biological and chemical. The appropriate treatment method depends on the species, site conditions, cost-efficiency, feasibility, safety and risk of environmental harm.

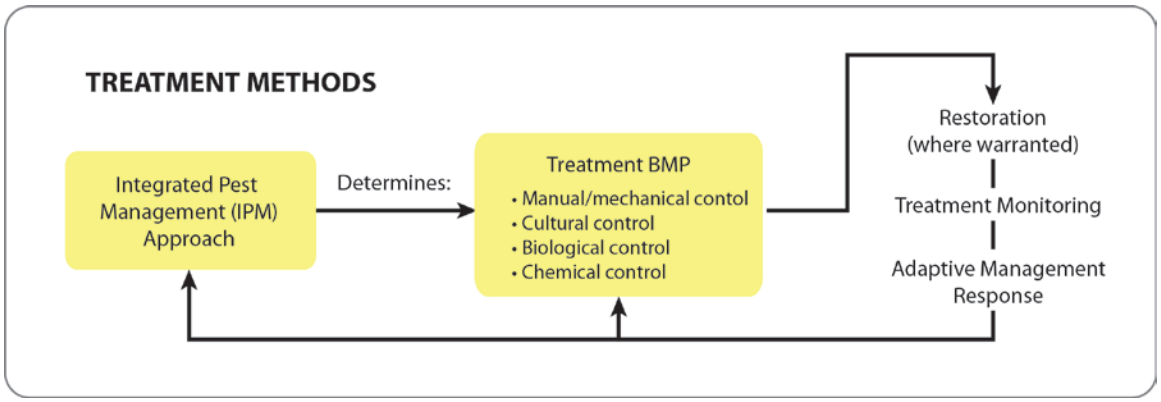


Figure 8. Treatment methods overview.

COMPARING TREATMENT METHODS

Manual/Mechanical: Using tools to physically remove the plants. This can include everything from hand tools to the use of excavators. Also include physical treatment such as covering infestations with plastic, cardboard or deep mulch to smother invasive plants.

- High cost, effectiveness can be variable, typically low environmental impact (but with poor practices can lead to further spread of invasive plants and further degradation of a site).

Cultural: Using techniques to encourage the establishment of a healthy vegetation layer that will resist or out-compete invasive plants. Examples including irrigating, fertilizing, re-vegetating, fill planting of trees. Restoration is a type of cultural control.

- Moderate to high cost, effectiveness highly variable, typically used in landscape, garden, agricultural settings. Can be used in environmentally sensitive areas.

Biological: Introduction of the plant's natural enemies (e.g. insects, parasites and pathogens) to reduce its population. Currently the only invasive plant species in the District with an approved bioagent is purple loosestrife. In the future bioagents may be available for knotweed, Scotch broom and gorse.

- Low to moderate cost, effectiveness is variable (may take years, may be unstable and will not eradicate a plant species), not available for most species, can cause incidental environmental impacts.

Chemical: Application of pesticides to control invasive plants. The District shares the concerns of the community about the use of pesticides and recommends the use of pesticides only when necessary for very high risk species when all other avenues of treatment have proven ineffective. Due to the risk posed by knotweed species and the ineffectiveness of mechanical treatments, current best management practices recommend the use of pesticides. There are, however, other situations when the use of pesticides may be necessary when other methods are not possible (e.g., large patches of hogweed, or sites inaccessible for mechanical removal). Pesticide use in the District is regulated under the Pesticide Use Control Bylaw. Permits are required for pesticide use.

- Low cost, highly effective, higher environmental risk and social concern, limitations in riparian areas

INTEGRATED PEST MANAGEMENT APPROACH

Integrated Pest Management (IPM) is a decision making process that uses a combination of techniques to suppress pests. The Pests Management Plan for the South Coast Mainland[32] describes it as:

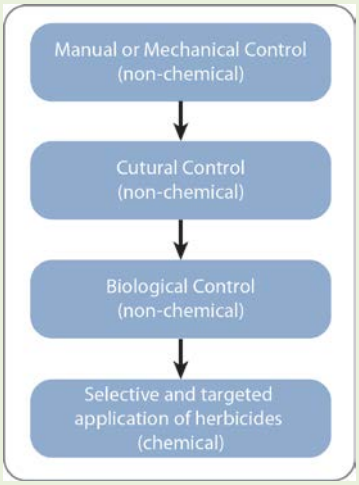
"In IPM programs, all information is considered in order to determine the best way to manage pest populations in an effective and environmentally sound matter. Preventing organisms for becoming pests, by keeping them at some acceptable level (i.e. below a level that causes damage), is the first step in any IPM program. When applied appropriately, an IPM process will result in improved management, lower costs, ease of maintenance and lower environmental impacts from control activities."

Under the BC *Integrated Pest Management Act*, IPM is required for pesticide use on public land. See Appendix 1. Section 1.4.2 for a complete definition.

CASE STUDY: IPM and Knotweed in the District

The District follows an IPM approach toward determining the appropriate invasive plant treatment method.

Chemical treatments are only used as a last resort for high risk species when the other methods are proven ineffective or impractical. This is the case for treating knotweed in the District.



- **Step 1: Evaluate manual or mechanical control**: Many trial manual and mechanical removals have been attempted including hand digging, deep excavation and deep burial. None of these methods proved to be effective, rather they lead to further growth and spread. For a time the District stock piled knotweed contaminated soil. However it soon became apparent that the space available for stockpiling was nowhere near sufficient to accommodate the volume of contaminated soil.

- **Step 2: Evaluate cultural control**: There are no documented methods of culturally controlling knotweed with the exception of planting conifer trees with the intent to eventually shade out the plant, a solution that could take decades and is impractical in most locations.

- **Step 3: Evaluate biological control**: To date there is no approved biological control for knotweed in Canada, however several insects and one pathogen are being tested in North America[33].

- **Step 4: Evaluate chemical control**: As a result of all three non-chemical treatment options being ineffective, impractical or unavailable, the District opted for chemical treatment of knotweed using glyphosate (a non-neonicotinoids pesticide) applied by either stem injection or foliar spray. There are provincial restrictions to applying pesticides in riparian areas; therefore knotweed within the restricted zone cannot be treated chemically.

ACTIONS:

24. Use the principles of Integrated Pest Management (IPM), provincial standards, and best management practices in all invasive plant control work.
25. Update invasive plant control best management practices as new information becomes available. These updates should be made through the *Staff Invasive Plant Working Group*.

[32] Ministry of Transportation and Infrastructure, Ministry of Environment, Ministry of Forests, Lands and Natural Resource Operations, and Ministry of Agriculture. 2011. Pest Management Plan for Invasive Alien Plant and Noxious Weed Control on Provincial Crown Lands within the South Coast Mainland of BC.

[33] Japanese Knotweed Biological Control http://www.fs.fed.us/foresthealth/technology/pdfs/FS_jaknotweed.pdf

4.4 Private Land

Objective: Encourage private land owners to manage invasive plants on their property.

The majority of land in the District is privately owned and the District has limited control of how these properties are managed at this time.

Invasive plant control on publicly owned lands has a limited effectiveness if they are allowed to grow on adjacent private lands. This is particularly troublesome in the case of aggressive and high risk species (namely knotweed and giant hogweed) which the District has already invested considerable resources in controlling.

The District has the option to regulate specific invasive plants on private property either by enforcing the *Weed Control Act* or enacting its own *Noxious Weed* bylaw (as permitted under the *Community Charter Act*). For private land under development, the development review process offers the District options to set requirements for invasive plant management either through the Development Permit Areas (DPAs) application process or as a component of the Master List Requirements (for development outside of the DPAs).

NOXIOUS WEED BYLAW: CASE STUDY

The City of Coquitlam enacted a Noxious Weed Bylaw in 2010 to regulate and prevent the spread of noxious weeds in the City. The bylaw requires that no owner or occupier of a property may allow a Noxious Weed to grow or remain on a property. The law pertains to any weed the City places on the bylaw list. To date giant hogweed is the only weed governed under the bylaw. The bylaw provides a mechanism for the City to require residents to treat giant hogweed on their property. Staff first confirm the identity of reported plants. If hogweed is confirmed then a letter is sent to the property owner setting a time frame to remove the plant before a ticket is issued. To date the bylaw has been very successful. The majority of residents comply and as of spring 2014 only one ticket has ever been issued.

Giant hogweed

ACTIONS:

26. Assess the potential effectiveness of creating a new District bylaw specific to the control of high risk invasive plant species. The District has the option to regulate specific invasive plants on private property either by enacting the *Weed Control Act* or enacting its own Noxious Weed bylaw (as permitted in the *Community Charter Act*). This has proven effective for managing specific high risk invasive plant species in several other B.C. municipalities (discussion in Appendix 1).
27. Educate residents about treatment options for high risk invasive plant species on private property through the proposed Invasive Plant Awareness Campaign (including a link to BMPs on the District's website). This mandate may change depending on the outcome of Action 29.
28. Formalize the protocol around invasive plant management in the Protection of the Natural Environment and Streamside Protection DPAs. Specifically:
    a. In Schedule B, incorporate a definition of invasive plant species.
    b. Include invasive plant species in the objective of the Protection of the Natural Environment DPA p. 19(4)
29. Explore opportunities to integrate invasive plant management into the Master Requirements List for development on non-DPA private lands, which development applicants must submit to the District for review of development plans.
30. Explore the possibility of requiring invasive plant surveys for development sites as part of Development

Permits to ensure that infestations are identified and managed during construction. Educate developers of their responsibilities to manage invasive plant species at the initial stages of development planning.

31. Educate developers of their responsibilities to manage invasive plant species at the initial stages of development planning.

5 RESTORATION – Restore natural habitat following treatment

5.1 Restoration Protocol

Objective: Ensure treatment areas recover before invasive plants can re-colonize.

The removal of invasive plants from a site is only one component of effective treatment. The resulting exposure of bare soil invites invasive plants to re-colonize. Depending on the degree of disturbance from removal of invasive plants, restoration may be warranted to ensure native plant communities re-establish.

Replanting a park site with native plants can be transformative for the surrounding neighbourhood improving its appearance, appeal, biodiversity value, and often accessibility. Restoration areas can improve public understanding of the risks of invasive plants, offer opportunities for community involvement and promote stewardship of parks. When volunteers are involved in re-planting they are likely to feel a vested interest in the success of the restoration efforts and are more likely to monitor the site over time.

Successful restoration planting is dependent on choosing plant species which are ecologically suited to the site conditions. Typically, primary succession trees and shrubs (those which naturally colonize disturbed sites) will have the highest survival rates. Appendix 7 contains restoration resources.

ACTIONS:

32. Develop a restoration protocol which defines (See Appendix 7):
    a. When restoration is necessary.
    b. What scope of projects require the expertise of a Qualified Environmental Professional (QEP).
    c. The required components of a restoration plan.
    d. Best management practices for all aspect of restoration works.
    e. Ecologically and site suitable species.

PART C: IMPLEMENTATION

1 Action Plan 2015-2020

The action plan includes all key recommendations within the Invasive Plant Management Strategy. They appear in the same sequence as the document. The action plan identifies the priority, phasing, relative cost, and operation or capital nature of each recommendation. Additionally, staff responsibilities for each action have been assigned.

Priority: The priority has been rated as either: very high, high, moderate, or low. All recommendations are considered important to action, regardless of priority.

Phasing:

- Short – within 2 years
- Medium – 3-5 years
- Long – more than 5 years
- Ongoing

Table 5. Action Plan 2015-2020.

ACTION PLAN		Priority	Phasing
AWARENESS – Goal: Communicate invasive plant management issues to staff, industry and the community.			
PUBLIC EDUCATION	**Objective: Devise and implement an invasive plant awareness campaign.**		
Action 1	Using other successful programs as models (e.g. City of Coquitlam's 'Bad Seed' Program, ISCMV's 'Knot on my Property' campaign), develop a communication plan for existing platforms (website, social media, print media, bus shelters etc.) with messaging that: a. Speaks to a wide audience (i.e. children, youth, and adults). b. Aims to change social norms and enhance understanding around invasive plant issues. c. Demonstrates how to take individual action. d. Offers opportunities for involvement in stewardship events.	Very High	Short

ACTION PLAN		Priority	Phasing
NURSERY & LANDSCAPE INDUSTRY	**Objective: Educate the local nursery and landscape industry on how to prevent the introduction and spread of invasive plants.**		
Action 2	Collaborate with neighbouring municipalities, the ISCMV and local nurseries to develop a North Shore program that enables nurseries to advertise that they do not sell the invasive plant species listed in Table 16 or Table 17 and provide educational information (e.g. Grow Me Instead booklet[34]).	Low	Long
Action 3	Educate landscapers and contractors of the risks posed by invasive plant species and discourage their use in landscaping through adherence to the BC Landscape Standard.	High	Medium
INTERNAL COMMUNICATION	**Objective: Continue to strengthen internal communication between staff and departments managing invasive plants.**		
Action 4	Form an internal *Staff Invasive Plant Working Group* that meets regularly with representation from all departments involved in invasive plant management and control projects to set priorities, share information and resources, and coordinate activities.	Very High	Short
Action 5	Ensure that invasive plant management roles and responsibilities are clearly defined between both staff and departments (See Appendix 2 for summary of existing roles and responsibilities).	Very High	Short
Action 6	Ensure that all staff who deal with and encounter invasive plants continue to receive adequate and up-to-date training appropriate to their position and responsibilities. Ensure staff are aware of appropriate contacts within the *Staff Invasive Plant Working Group* with regard to specific issues they may encounter.	Very High	Ongoing
Action 7	Familiarize District staff with the Invasive Plant Management Strategy focusing on its goals and objectives.	Very High	Short/ Ongoing
PREVENTION – Goal: Prevent new invasive plants from establishing and spreading.			
PREVENTION BMPS	**Objective: Apply best management practices (BMPs) for prevention of invasive plant spread on municipal lands.**		
Action 8	Continue to work with the BCLNA and BCSLA on establishing invasive plant prevention practices and standards.	Medium	Ongoing
Action 9	Adopt Best Management Practices for preventative techniques to reduce the risk of invasive plant establishment and spread (Appendix 6).	Very High	Short

[34] ISCBC Grow Me Instead Booklet http://bcinvasives.ca/resources/publications/grow-me-instead-booklet

ACTION PLAN		Priority	Phasing
GREEN WASTE DUMPING	**Objective: Prevent green waste dumping and park encroachment by landscape contractors and residents.**		
Action 10	Amend the Park Control Bylaw to include the prohibition of dumping invasive plant material. Enhance compliance and enforcement by increasing the fine for infractions and allowing staff who deal with illegal dumping to issue “Order to Comply” notices.	High	Short
Action 11	Educate residents about the Park Control Bylaw, consequences, cost of green waste dumping and park encroachment through the proposed Invasive Plant Awareness Campaign, and encourage the use of alternatives for disposal (i.e. green waste pickup). See species specific BMPs in Appendix 6 for disposal guidelines.	Very High	Medium
Action 12	Educate landscapers and contractors about the Park Control Bylaw, consequences and cost of green waste dumping and park encroachment through the business permit process.	High	Medium
SOIL	**Objective: Prevent the movement and improper disposal of soil contaminated by invasive plants.**		
Action 13	Assess whether developing a new soil bylaw is warranted or if amending the District's Environmental Protection and Preservation Bylaw to include the management of soils contaminated by invasive plants is sufficient to address the problem.	High	Medium
Action 14	Incorporate specifications for contaminated soil management in the District's master specification. Update corporate policy to ensure that developers are aware of this requirement. Include this in the environmental review for developers. A Qualified Environmental Professional (QEP) would be required to ensure that soils are free of invasive plant species prior to issuance of a soil permit.	High	Medium
Action 15	Develop internal and external BMP factsheets to guide soil management and disposal. Until a regional solution is developed the best practice for knotweed contaminated soil is to adequately treat the infestation prior to soil movement and to keep contaminated soil on site, contained in one location and monitored for the long-term.	High	Medium
Action 16	Work with neighbouring municipalities and regional government to develop soil transfer and disposal regulations and adopt regional "invasive free" certification for soil and mulch products. Encourage regional coordination of provincial direction on this issue.	High	Medium

ACTION PLAN		Priority	Phasing
DETECTION – Goal: Detect invasive plants early and accurately.			
EARLY DETECTION	**Objective: Implement an Early Detection and Rapid Response (EDRR) system**		
Action 17	Formalize an EDRR protocol. Specifically: a. Designate the responsibilities of District EDRR to a staff position to respond to reports (from staff and the public) of new arrivals to confirm species identification, map their location and arrange appropriate treatment (District land) or inform the landowner. b. Maintain a 'watch list' of plants likely to be invasive in the District and communicate updates to the proposed *Invasive Plant Working Group* (see the current Watch List in Appendix 5. c. Communicate with agencies who host provincial and regional public reporting mechanisms to ensure that sightings reported within the District get addressed in a timely manner (e.g., the Provincial Invasive Alien Plant Program 'Report-a-Weed' tool, the Royal BC Museum's 'Aliens Among Us' website, and sightings reported directly to the ISCMV). d. Report occurrences of provincial EDRR species to the Provincial EDRR coordinator.	Very High	Short
INVENTORY	**Objective: Develop and maintain an invasive plant inventory on District owned land**		
Action 18	Transition existing inventory into, and store future inventory data within, the District's invasive plant mapping tool (transition process described in Appendix 4).	Very High	Short/ Ongoing
Action 19	Train and equip all staff that manage invasive plants in the field on the use of the invasive plant mapping tool (to maintain and augment the inventory).	High	Ongoing
Action 20	Undertake a complete, up-to-date spatial inventory of invasive plants. A phased approach is described in Appendix 4. The inventory will provide the following information: a. A measure of abundance and distribution pattern. b. A record of treatment either recommended or completed. c. An understanding of budget requirements for treatment. d. Monitoring results of infestation response following treatment.	High	Ongoing

ACTION PLAN		Priority	Phasing
TREATMENT – Goal: Control invasive plants strategically, efficiently and effectively.			
TREATMENT PRIORITIES	**Objective: Set treatment priorities by evaluating species risk and treatment feasibility.**		
Action 21	Use the Species Priority and Park Land Priority as decision tools to guide treatment priorities.	Very High	Ongoing
TREATMENT PROGRAM	**Objective: Carryout a strategic District wide invasive plant control program.**		
Action 22	Develop an annual work plan and budget for each invasive plant control project. Each project should have a staff coordinator who acts as the contact person and is a member of the *Staff Invasive Plant Working Committee*. This coordinator is also responsible for ensuring all treatment sites are recorded in GeoWeb using the invasive plant mapping tool and ensuring proper monitoring records are kept for all treatment projects.	Very High	Ongoing
Action 23	Devise a permit requirement for community groups who wish to carryout invasive plant control work which is reviewed by a staff coordinator. House this permit within the Parks Control Bylaw.	Mod	Medium
TREATMENT BMPS	**Objective: Apply best management practices in all invasive plant control work.**		
Action 24	Use the principles of Integrated Pest Management (IPM), provincial standards, and best management practices in all invasive plant control work.	Very High	Ongoing
Action 25	Update invasive plant control best management practices as new information becomes available. These updates should be made through the *Staff Invasive Plant Working Group*.	High	Ongoing
PRIVATE LAND	**Objective: Encourage private land owners to manage invasive plants on their property.**		
Action 26	Assess the potential effectiveness of creating a new District bylaw specific to the control of high risk invasive plant species. The District has the option to regulate specific invasive plants on private property either by enacting the *Weed Control Act* or enacting its own Noxious Weed bylaw (as permitted in the *Community Charter Act*). This has proven effective for managing specific high risk invasive plant species in several other B.C. municipalities (Appendix 1).	High	Short
Action 27	Educate residents about treatment options for high risk invasive plant species on private property through the proposed Invasive Plant Awareness Campaign (including a link to BMPs on the District's website). This mandate may change depending on the outcome of Action 29.	High	Medium

ACTION PLAN		Priority	Phasing
Action 28	Formalize the protocol around invasive plant management in the Protection of the Natural Environment and Streamside Protection DPAs. Specifically: c. In Schedule B, incorporate a definition of invasive plant species. d. Include invasive plant species in the objective of the Protection of the Natural Environment DPA p. 19(4) e. Require any development falling within these DPAs to provide a survey for invasive plan species and subsequent mitigation if they are detected.	High	Short-Medium
Action 29	Explore opportunities to integrate invasive plant management into the Master Requirements List for development on non-DPA private lands, which development applicants must submit to the District for review of development plans.	High	Short
Action 30	Explore the possibility of requiring invasive plant surveys for development sites as part of Development Permits to ensure that infestations are identified and managed during construction.	High	Short-Medium
Action 31	Educate developers of their responsibilities to manage invasive plant species at the initial stages of development planning.	High	Short-Medium
RESTORATION – Goal: Restore natural habitat following treatment.			
RESTORATION PROTOCOL	**Objective: Develop a restoration protocol to ensure treatment areas recover before invasive plants can re-colonize.**		
Action 32	Develop a restoration protocol which defines (See Appendix 7 for resources): a. When restoration is necessary. b. What scope of projects require the expertise of a Qualified Environmental Professional (QEP). c. The required components of a restoration plan. d. Best management practices for all aspect of restoration works. e. Ecologically and site suitable species.	High	Medium

2 A living Document: Adaptive Management

Managing invasive plant species is a long term and ongoing task. New species will emerge over time presenting new challenges for control. The rate of landscape change in urban environments must also be considered. A growing population will continue to put stress on local ecosystems as demand for land, water and resources increases. Many of the recommendations contained within this Strategy are likely not achievable within a short time frame. The plan begins with the assumption that it will take the District many years to achieve some of the stated goals.

The IPMS should be considered a living document that will require periodic updates. An adaptive management approach will integrate new management initiatives, scientific research, monitoring results and community input. The premise of adaptive management is continual learning. Periodic review and updating of the Strategy will facilitate integration of an adaptive management approach. This ensures that the plan continually follows best management practices and reflects the vision of the community.

Adaptive Management and Monitoring Recommendations for the *Staff Invasive Plant Working Group*:

1. Annually evaluate the quality and efficacy of the mapping tool (GeoTool) and inventoried data. Update the inventory every 5-10 years.
2. Evaluate the Species Priorities every 2-3 years: update the risk assessment and invasion phase as new information becomes available. Add new species as they are detected.
3. Evaluate the Park Land Priorities every 2-3 years.
4. Carry-out an annual evaluation of all invasive plant treatment work amongst all involved staff as a means to translate lessons learned into future decisions and practice adaptive management.
5. Carry-out an annual evaluation of the progress of the Action Plan.

Youth volunteers remove invasive plants from District parks

Part D: Appendices

1 Appendix 1. Policy & Regulatory Context Discussion

1.1 Federal Context

The federal *Plant Protection Act* and *Seeds Act* restrict the import, movement, sale, and/or propagation specific invasive plants into Canada (Table 6). These Acts are administered by the Canadian Food Inspection Agency. The Acts are not considered important regulatory tools at the municipal level.

Table 6. Summary of federal legislation related to invasive plants.

Jurisdiction	Regulation/Bylaw	Relevance & Discussion
Federal	*Plant Protection Act* S.C. 1990, c.22	Identifies a list of plants that are considered *Pests* in Canada. Regulates the distribution of these species.
	Seeds Act, R.S.C. 1985, c. S-8	Regulates the distribution of the seeds of species that are designated as *Prohibited Noxious Weeds*.

Some of the regulated plant species are restricted because they are hosts of diseases or pathogens (e.g. *Berberis* and *Mahonia spp.* are subject to phytosanitary requirements due to their role as alternate host of black stem rust disease). A complete list of regulated species (including plants) can be found at http://inspection.gc.ca/plants/plant-protection/pests/regulated-pests/eng/1363317115207/1363317187811

1.2 Provincial Context

Provincially, there are two regulatory options offered to municipal governments to manage invasive plants[35]: the *Weed Control Act* and the *Community Charter Act* (Table 7).

Table 7. Summary of provincial legislation related to invasive plants.

Jurisdiction	Regulation/Bylaw	Relevance & Discussion
Provincial	*Weed Control Act* [RSBC 1996] CHAPTER 487	The Act places a duty on all land occupiers (public and private) to control listed noxious weed species The Act pertains to all land except federals lands. It can only be enforced by a weed instructor appointed by the Minister, or by an inspector appointed by local government under the *Act*.
	Community Charter Act	Authorizes municipalities to regulate invasive plants on private property through the use of bylaws. Regulatory powers depend on the threat posed (environmental, nuisance or public health concern).

The ***Weed Control Act*** originally targeted agricultural, forest and range weeds. In recent years the noxious weed list has been expanded to include urban noxious weeds such as knotweed and giant hogweed. In North Vancouver the following species are listed as noxious weeds: giant hogweed, knotweed species, purple loosestrife and yellow flag-iris. Enforcement is limited to an appointed inspector.

[35] Invasive Plant Council of BC. Report #14 - Local Government Toolkit for Invasive Plant Management. December 2010.

The ***Community Charter Act*** allows municipalities to create bylaws to control invasive plants. This regulatory route offers municipalities more flexibility than the *Weed Control Act* particularly in defining target species and enforcement parameters that are locally important.

Several BC municipalities and regional districts successfully use the *Weed Control Act* or *Community Charter Act* as regulatory tools. Some examples of jurisdictions with noxious weed bylaws are: City of Coquitlam (see infobox on page 34 for a discussion of Coquitlam's noxious weed bylaw), District of Saanich and Comox Valley Regional District. The Resort Municipality of Whistler recently enacted an Environmental Protection bylaw which includes regulating certain invasive plants. These bylaws are compared in Table 8. The Peace River Regional District is an example of a jurisdiction which actively enforces the *Weed Control Act*.

Other municipalities are informally using the *Weed Control Act* as a means to request that private property owners treat giant hogweed. Both the City of Richmond and City of Surrey have had success with this approach.

Table 8. Example weed related bylaws in other BC South Coast municipalities.

Jurisdiction	Bylaw Reference	Target Species
Coquitlam	Noxious Weed Bylaw http://publicdocs.coquitlam.ca/cyberdocs/getdoc.asp?doc=1003031	Giant hogweed
Saanich	Noxious Weed Bylaw http://www.saanich.ca/living/pdf/weeds8080.pdf	Wild mustard Canada thistle Ox-eye daisy Bindweed or morning glory Wild carrot Couchgrass/quackgrass Purple loosestrife Giant hogweed Poison hemlock Garlic mustard Blessed milk thistle Knotweed species
Whistler	Included under the Environmental Protection Bylaw http://www.whistler.ca/environmental-protection-bylaw	Regulated species are at the discretion of the Ski to Sky Invasive Species Council. Current 2014 list: Scotch broom Spanish broom Purple loosestrife Japanese knotweed Yellow flag-iris Flowering rush Himalayan blackberry
Comox Valley Regional District	Weed Control Regulation Bylaw http://www.comoxvalleyrd.ca/EN/main/community/environmental/invasive-plants-alternatives.html	Purple loosestrife Japanese knotweed Yellow flag-iris Spotted knapweed English ivy Giant hogweed Scotch broom Gorse Dalmation toadflax Himalayan blackberry

1.3 Municipal Context

1.3.1 Bylaws

The District currently has three bylaws which relate to invasive plant control (Table 9); however, there is no explicit noxious weed bylaw. Each existing bylaw is discussed below (municipal pesticide bylaws are discussed in Section 1.4).

Table 9. Summary of existing federal and provincial regulations related to invasive plant management.

Jurisdiction	Regulation/Bylaw	Relevance & Discussion
Municipal (DNV)	*Environmental Protection and Preservation Bylaw* No. 6515, 1993	Provides protection and preservation guidelines for aquatic areas, slopes, and soils. A permit is required for the removal or depositing of any soil.
	Park Control Bylaw No. 2733, 1961	Prohibits dumping of waste within parks.
	Nuisance Abatement Bylaw No. 7325, 2002	Requires property owners to keep property clear of noxious weeds.

1. **Environmental Protection and Preservation Bylaw** This bylaw enables the District to manage the spread of soil which is a major factor in the spread of invasive species. The bylaw could be amended to include the management of soils contaminated with invasive plant material.

2. **Park Control Bylaw** prohibits dumping of waste but does not specify if this includes green waste and invasive plant material. The bylaw is difficult to enforce because it is difficult to catch someone in the act of dumping. The current fine for an infraction is too low to be an effective deterrent and only one bylaw officer is permitted to issue tickets. Enabling multiple staff to issue “Order to Comply” notices and increasing the fine would greatly enhance the District’s enforcement capabilities with regards to dumping. As of 2014 this bylaw is under review.

3. **Nuisance Abatement Bylaw** states that properties should be kept clear of noxious weeds because of their visual amenity impact. However, this bylaw does not address the more serious concerns regarding environmental degradation. The bylaw refers to ‘clearing’, which may not illicit an appropriate response to invasive plant treatment. Further, the bylaw only applies to provincially listed species on the noxious weed list.

Several actions are recommended related to changes or amendments to bylaws. They are replicated below from the Action Plan.

Action 10	Amend the **Park Control Bylaw** to include the prohibition of dumping invasive plant material. Enhance compliance and enforcement by increasing the fine for infractions and allowing staff who deal with illegal dumping to issue “Order to Comply” notices.
Action 13	Assess whether developing a new soil bylaw is warranted or if amending the District's **Environmental Protection and Preservation Bylaw** to include the management of soils contaminated by invasive plants is sufficient to address the problem.
Action 23	Devise a permit requirement for community groups who wish to carryout invasive plant control work. House this permit within the **Parks Control Bylaw**.
Action 26	Assess the potential effectiveness of creating a **new District bylaw** specific to the control of high risk invasive plant species. The District has the option to regulate

	specific invasive plants on private property either by enacting the *Weed Control Act* or enacting its own Noxious Weed bylaw (as permitted in the *Community Charter Act*). This has proven effective for managing specific high risk invasive plant species in several other B.C. municipalities (Appendix 1).

1.3.2 Development Review Process

The District has Development Permit Areas (DPAs) which allow for specific restrictions on development activities including requirements for environmental assessments. Two of the DPAs are in place to protect the natural environment: the Protection of the Natural Environment DPA and the Streamside Protection DPA. As part of the development permit review process, any development falling within these DPAs should require a survey for invasive species and subsequent mitigation if they are detected.

For development outside of the DPAs, invasive plant management can be required as part of the Master List Requirement (MLR) which development applicants must submit to the District for review of development plans.

Several actions are recommended related to changes to the development review process. They are replicated below from the Action Plan.

Action 28	Formalize the protocol around invasive plant management in the Protection of the Natural Environment and Streamside Protection DPAs. Specifically: a. In Schedule B, incorporate a definition of invasive plant species. b. Include invasive plant species in the objective of the Protection of the Natural Environment DPA p. 19(4) c. Require any development falling within these DPAs to provide a survey for invasive plan species and subsequent mitigation if they are detected.
Action 29	Integrate invasive plant management into the Master Requirements List for development on non-DPA private lands, which development applicants must submit to the District for review of development plans.
Action 30	Require invasive plant surveys for development sites (excluding single family) as part of Development Permits to ensure that infestations are identified and managed during construction.
Action 31	Educate developers of their responsibilities to manage invasive plant species at the initial stages of development planning.

1.3.3 Policy

The purpose, goals, objectives and actions of the District's Invasive Plant Management Strategy align with numerous policies in the *Official Community Plan* and *Plans and Open Space Strategic Plan*. Relevant policies are listed in Table 10.

Table 10. Summary of policy references in the District's OCP and POSSP which align with the Invasive Plant Management Strategy.

District Policy Document	Policy number	Page
Official Community Plan (OCP) **http://www.dnv.org/upload/pcdocsdocuments/1vzgx01_.pdf**	9.1 Biodiversity – Policies: 5,8,9,11 9.2 Urban Forest and Soil Systems – Policies: 1,3,4,5,6 9.3 Aquatic Ecosystems – Policies: 2,6,7 9.6 Community Stewardship – Policies: 1,2,3,4,5 10.4 Climate Change Adaptation – Policy: 4	67 68 69 70 75
Parks and Open Space Strategic Plan (POSSP) http://www.dnv.org/upload/pcdocsdocuments/13kgf01!.pdf	6.2.01 Sustainable Park Restoration and Development 6.2.05 Urban Beautification and Horticulture 6.3.04 Alpine Areas: Alpine Recreational Strategic Framework – Balancing environmental protection with recreational management 6.4.01 Environmental Planning and Management 6.4.03 Management of Public Forest Ecosystems 6.4.05 Protection of Sensitive Ecosystems and Core Habitat Values 6.4.06 Wildlife Program 6.4.07 Riparian and Storm Water Management 6.4.08 Invasive Species Management 6.4.09 Environmental Stewardship 6.4.10 Encroachment and Enforcement Management 6.5.02 Volunteerism	26 31 43 46 47 49 49 49 50 50 50 52

1.4 Pesticide Regulation

Pesticides in Canada are regulated at three levels of government as outlined in Table 11[36]. The following subsections provide summaries of legislation and resources relevant to the District with regard to pesticide use to control noxious weeds and invasive plants on public and private land. A comprehensive guide to pesticide use and legislation was published by West Coast Environmental Law in 2007 (A Citizen's Guide to Pesticide Use and the Law in BC) and is available on the District's website: http://www.dnv.org/upload/documents/A%20Citizen's%20Guide%20to%20Pesticides%20and%20BC%20Law.pdf

Table 11. Jurisdictional pesticide regulation responsibilities in Canada.

Jurisdiction	Principal Responsibilities	Acts and Regulations
Federal	• Pesticide registration and re-evaluation • Human health and safety • Environmental impact • Value/efficacy assessment • Alternative strategies • Compliance and enforcement	*Pest Control Products Act*
Provincial	• Transportation, sale, use, storage/disposal • Training/certification and licensing of applicators/vendors • Spills/accidents • Permits/use restrictions • Compliance and enforcement	*Integrated Pest Management Act* and Regulations

[36] Health Canada: The Regulation of Pesticides in Canada. http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/reg-pesticide/index-eng.php

Jurisdiction	Principal Responsibilities	Acts and Regulations
Municipal (District of North Vancouver)	• By-laws for municipal lands only	*Pesticide Use Control Bylaw* No. 7686, 2009 *Notification of Pesticide Use Bylaw* No. 6375, 1991

1.4.1 Federal

Health Canada's Pest Management Regulatory Agency's (PMRA) mandate is "to protect human health, safety and the environment by minimizing risks associated with pesticides, while providing Canadians access to the pest management tools they require for agriculture, forestry, industry, and personal use".

The PMRA administers the ***Pest Control Products Act*** which regulates all pesticides imported, sold or used in Canada.

Relevance to DNV:

- The pesticide product label contains the conditions of registration which govern the use of the product.

Resources:

- **Regulation of Pesticides in Canada** (Health Canada) http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/reg-pesticide/index-eng.php
- **Cosmetic Pesticide Bans and the Roles of the Three Levels of Government** (Health Canada) http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/gov-roles-gouv/index-eng.php
- **Homeowner Guidelines for Using Pesticides** (Health Canada) http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/home-maison/index-eng.php
- **Homemade Pesticides** (Government of Canada) http://healthycanadians.gc.ca/healthy-living-vie-saine/environment-environnement/pesticides/homemade-maison-eng.php
- **Bees** (Health Canada):
    - **Update on Actions to Protect Bees from Exposure to Neonicotinoids** http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/protect_bee-proteger_abeilles-eng.php
    - **Protecting Pollinators during Pesticide Spraying – Best Management Practices** http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/pollinator-protection-pollinisateurs/index-eng.php

1.4.2 Provincial

The BC ***Integrated Pest Management Act*** (IPMA) and Regulation presides over the sale, storage, transport and use of pesticides in BC. It outlines training requirements, certification, licensing of businesses that sell or apply pesticides for a fee, and requirements for pesticide application to public land.

Relevance to DNV:

- Requires that pesticides must be used in accordance with their federal labels.
- Requires that no person should use a pesticide in a way likely to cause an unreasonable adverse effect to human health and or the environment, or contrary to the IPMA.

- Requires the use of Integrated Pest Management for pesticide use on public land. IPM is defined as 'a process for managing pest populations that includes the following elements:
    a) Planning and managing ecosystems to prevent organisms from becoming pests;
    b) Identifying pest problems and potential pest problems;
    c) Monitoring populations of pests and beneficial organisms, damage cause by pests and environmental conditions;
    d) Using injury thresholds in making treatment decisions;
    e) Suppressing pest populations to acceptable levels using strategies based on considerations of
        i. Biological, physical, cultural, mechanical, behavioural and chemical controls in appropriate combinations, and
        ii. Environmental and human health protection;
    f) Evaluating the effectiveness of pest management treatments.'
- Specifies requirements by pesticide class (e.g. whether applicator license, user license, Pest Management Plan, pesticide use notice, applicator certificate or pesticide use permit are required). Pesticide class is included on the pesticide label.
    - A Pesticide Use License is required by an individual, company or government organization who manages noxious weeds or invasive plants on up to 50 ha/year of public land. If the total area of land exceeds 50 ha/year then the company or agency must develop a Pest Management Plan (PMP) and obtain a pesticide use notice confirmation. The District has a Pesticide Use License (170062) and a PMP (12-6030-2).
    - Pesticide Use Licensees are required to:
        - Notify the public of pesticide use in outdoor public use areas, school property, child care facilities and outdoor common area of multi-residence buildings or properties. The information required on a treatment notice is provided below in the Resources section. The required notification period for posted signage is: 72 hour pre and 48 hours post for schools and child care facilities; 48 hours pre and post for outdoor common areas of multi-residence buildings or properties; and before use to 48 hours post in outdoor public use areas.
        - Submit annual pesticide use records to the Ministry of Environment.
    - An Applicator Certificate is required to manage weeds designated as noxious on private or public land under the "Industrial Vegetation and Noxious Weeds" classification.

Changes are in the works: A pesticide use license will be required for applications on private land. There may be exceptions for glyphosate used for certain invasive plant situations. A certified applicator will no longer be able to supervise uncertified individuals (anyone doing fee-for-service, public land, ROW, and forest land must be trained).

Resources:

- Ministry of Environment – Integrated Pest Management Act and Regulation:
  Summary of legislation:
  http://www.env.gov.bc.ca/epd/ipmp/regs/pdf/leg_summary.pdf
  Legislation: http://www.env.gov.bc.ca/epd/ipmp/regs/index.htm

- Summary of provincial legislation governing aspects of pesticide use: http://www.al.gov.bc.ca/pesticides/i_4.htm
- Pesticide use treatment notice: http://www.env.gov.bc.ca/epd/ipmp/forms/pesticide-treatment.htm
- Pesticide use reporting: http://www.env.gov.bc.ca/epd/ipmp/forms/reporting.htm
- Pesticide certification: http://www.env.gov.bc.ca/epd/ipmp/pest_certification/certif_main.htm

1.4.3 Municipal (District of North Vancouver)

The District has two bylaws pertaining to pesticide use:

1. **Pesticide Use Control Bylaw** enables the District to permit pesticide use in cases where there is a danger to human or animal health or damage to buildings and structures. Knotweed and giant hogweed both fit these criteria. Pesticide permits cannot be issued on private property for other invasive plants for which pesticide is typically the most effective treatment method and which may pose significant ecological harm (but do not pose a risk to health or infrastructure). In addition permits can be issued for application of pesticides to public land where there is in place an Integrated Pest Management Program.
2. **Notification of Pesticide Use Bylaw** specifies requirements for pesticide notification signage including that it must be posed 72 hours prior to pesticide application and remain posted for 72 hours after application. It details the required contents of the sign. It does not apply to the application of pesticides to areas covering less than 10% of a park or other open area when such area does not exceed 0.8 hectares. This means that in most cases, chemical treatment of knotweed or giant hogweed would be except based on being under 0.8 ha. **This bylaw requires a longer notification period than what is required under the provincial *IPMA***.

2 Appendix 2. Staff and Departmental Roles and Responsibilities

The table below summarizes current staff and departmental responsibilities for invasive plant management. New roles and responsibilities will be required to carry out this Strategy. These are incorporated in the Action Plan.

Table 12. Existing and proposed invasive plant management roles and responsibilities of staff and departments.

Department	Staff	Roles and Responsibilities
Parks	Manager	• Policy, budgeting, planning on park land • Direct park staff
	Horticulture	• Invasive plant removal in landscape beds, medians, trails, creek and natural parkland • Deal with resident complaints • Removal of illegally dumped green waste; communicate with adjacent residents; issues bylaw infraction tickets for illegal dumping (proposed role)
	Trail & Habitat	• Invasive plant removal in parks and natural parkland (not covered

Department	Staff	Roles and Responsibilities
		by parks crews) • Treatment of single site occurrences (1-10 plants) of giant hogweed in parks • Organize and supervise stewardship volunteers and other groups for invasive plant removal and restoration planting • Carryout public education activities including of school groups
	Turf	• Invasive plant removal in sport fields and mowed areas
	Arborist	• Manage treatment of noxious weeds (knotweed and giant hogweed) in District Lands managed by Parks and Streets • Coordinate treatment of noxious weeds (mostly hogweed) with other agencies (MOT, BC Hydro, and First Nations) • Supervise contract crews who treat noxious weeds by pesticide application • Carryout pesticide application of small noxious weed infestations (1-10 plants)
Environment	Manager	• Policy on private land • Direct environment staff • Climate Change Adaptation Planning and local government Working Group for SEAR as they relate to invasive plants and biodiversity • Responsible for pesticide bylaw
	Environmental Protection Officer	• DPA administration as it relates to invasive plants • Issue Pesticide Permits under Pesticide Bylaw • Inspect for noxious weeds on private land
	Technician	• Address invasive plant issues on private land and development sites • Issue Pesticide Permits under Pesticide Bylaw • Involvement with DPA • Deal with resident complaints
	Community Forester	• Policy on private land from a community forestry perspective • Inspect for noxious weeds on private land • Involvement with DPA • Wildfire fuel treatment as it relates to invasive plants
Development and Planning		• Identify invasive plants on development sites • Provide invasive plant information to developers
Streets	Manager	• Direct street inspector staff
	Street Inspector	• Locate noxious weeds (knotweed and giant hogweed) on District boulevards and street allowances
Engineering, Construction, Facilities	Site Manager	• Identify invasive plant concerns on project sites and get direction from parks and/or environment
Utilities	Manager	• Identify invasive plant concerns on project sites and get direction from parks and/or environment
Communications	Communications Advisor	• Develop and support communication strategies
Bylaw	Bylaw Officer	• Deal with resident complaints • Issue bylaw infraction tickets

3 Appendix 3. Signage Discussion

Designing compelling signage can contribute to a successful invasive plant awareness campaign. Historically plain text “No Dumping” signs have proven ineffective, as evidenced by dumped refuse beneath the sign. Conversely, simple graphic signs have been successful in denoting wildlife trees, sensitive restoration areas and ‘no mow’ zones for knotweed.

Opportunities for signage and information:

- ***Dumping of green waste*** – “Don’t leave me here!” These should graphically communicate the negative impacts of green waste dumping (including the clean-up cost) and the proper means of disposal. Signage should be located in dumping ‘hot spots’ as well as incorporated into park entry signage.
- ***Invasive species free zone*** – “This is not my home!” These signs should be posted at recreation entrances to natural areas that are identified as predominately natural and a priority for eradication of invasive plants.
- ***Park Boundary signs*** – Some municipal parks are used regularly for dumping green waste, as well as degraded by encroachment. Signs to delineate park boundaries and remind residents of their contribution to park stewardship can help reduce these problems.
- ***Educational kiosks*** – At strategic locations, more detailed kiosk style information can be developed. These would illustrate the priority species of concern, their risks and management. Maps showing inventories and treatment area priorities and restoration sites could also be displayed.

4 Appendix 4. Inventory Discussion

4.1 Evaluation of existing inventory datasets

The District currently has four sources of inventory data. All offer some degree of value but none provide a stand-alone, complete inventory of the entire District-owned land base. Table 13 identifies each inventory source and summaries their value and deficiencies. It should also be recognized that District staff involved in invasive plant management offer a wealth of inventory knowledge gleaned from their work on the ground. Over time or with staff changes this information can easily be lost or forgotten if not properly documented.

Table 13. Existing invasive plant inventory knowledge in the District.

Inventory	Year	Format	Value	Deficiencies
Forest Ecosystem Mapping (Blackwell)	2009	Spatial point locations in ESRI geodatabase	• Relative distribution of the most abundant invasive plant species in the District. • Valuable as a historic record.	• Outdated. • Limited to 11 invasive plant species. • Scale is too broad (not accurate when field checked). Not fine scale enough to be used as a planning tool to prioritize treatment areas or to direct crews to specific locations for operations.
Invasive Plant Strategy – Preliminary Report (Knox)	2011	Spatial point locations housed online at *What's Invasive App*[37]	• All observed invasive species were included. • Wider scope than any other dataset. Useful to examine distribution patterns	• Scope confined to sensitive ecosystems. • Locations only, no measure of infestation size. • Would need to be extracted from *What's Invasive App* website into ESRI geodatabase for internal use.
IAPP	Various	Spatial point locations housed online at IAPP	• Not limited to park land or municipal land. • Treatment and monitoring information may be recorded for some sites.	• Piece-meal inventory. Difficult to understand under what circumstances or purpose records were made (e.g. do records within a park parcel indicate a complete inventory was undertaken?) • Limited display and analysis abilities in IAPP interface. • Would need to be extracted from IAPP into ESRI geodatabase for internal use. • District has limited control over data. Any approved IAPP user can enter data.
Hogweed and	Ongoing	Spreadsheet	• Extremely valuable	• Potential for lost records or

[37] http://www.whatsinvasive.org/park.cfm Choose 'District of North Vancouver' from 'Participating Site' dropdown menu.

Inventory	Year	Format	Value	Deficiencies
knotweed treatment program	.	record of address locations	treatment and monitoring records.	extra time spent locating plants on the ground (particularly for contractors). • Spreadsheet format does not allow for visual display or interpretation of spatial distribution.

4.2 Comprehensive inventory in GeoWeb: Transition and phased approach

The following outlines a proposed methodology for building a comprehensive invasive plant inventory in GeoWeb using the invasive plant mapping tool (a GeoTool). It includes taking advantage of existing inventory datasets. Ideally the GeoTool would be loaded onto tablets for inventory on the ground and later uploaded into GeoWeb.

1. **Historic Records**
    a. Translate all hogweed and knotweed treatment locations from spreadsheet records to GeoWeb as point or polygon spatial data. Going forward all treatment locations (whether treated by staff, contractors or volunteers) should be recorded in GeoWeb.
    b. Amalgamate historic inventory from the 2011 C. Knox inventory (stored online at www.whatsinvasive.org) and IAPP records into one GIS geodatabase. Use this as a temporary inventory base layer of point locations displayed as a background layer on the tablets. Any one carrying out inventory work should check these locations to ensure they are properly captured in the new comprehensive inventory.
2. **Setting Inventory Priorities**: Increase inventory efficiency and utility by prioritizing high risk and high likelihood sites as well as not inventorying the most widespread species.
    a. Narrow the inventory to highest likelihood site types: park perimeters, travel corridors (trails, roads, access points) and riparian corridors. Surrey uses this methodology after finding that the vast majority of invasive plant occurrences are visible from trails, roads, park perimeters and riparian areas. There was very limited value in traversing interior park parcels with no trail access or evidence of disturbance.
    b. Implement a phased approach. The Park Land Priority Groups could help determine inventory priorities.
    c. Don't inventory plant species which are already ubiquitous across the landscape unless there is a unique site specific risk/hazard (e.g. blocking recreation access, impeding valued viewscapes). This applies to cherry laurel and English holly (and possibly spurge laurel). These species are here to stay and will continue to be spread by birds.
    d. Include EDRR species in the inventory as an opportunity to raise their profile and ensure search effort and recording, both citizens and staff, is high.
3. **Inventory Opportunities**: Under ideal circumstances, the District would carry out a complete inventory exercise within one year, repeated every 5 years. Since funds may

be limited and not allow for such an endeavour, take advantage of all opportunities for inventory work such as:

a. Staff involved in invasive plant management should always carry a tablet in order to inventory as they have time at their work site.
b. Experienced volunteers could be assigned park parcels for inventory.
c. All treatment and control work should require timely updates to the inventory and treatment records.

4. Value Added Components

a. Include other important information when collecting inventory data such as green waste/garbage dumping sites and park encroachment.

4.3 IAPP vs. GeoWeb

The BC Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) administers the Invasive Alien Plant Program (IAPP). IAPP is on online database of invasive plant locations, treatments and activity plans across the province[38]. Municipalities can choose to use IAPP as can a variety of other user groups such as ministries, regional districts, utilities, conservation groups, etc.

In the experience of the authors of this Strategy, IAPP is somewhat cumbersome and in-flexible. When municipalities have in-house GIS and mapping expertise and their own internal mapping platforms, it makes sense to utilize these resources rather than use IAPP. This is the case with District, which has a GIS department and an award winning mapping platform, GeoWeb. The District has already invested the time in developing an online mapping tool for invasive species that will support its management needs. Using GeoWeb offers the District far more control over their invasive species data in every facet including data entry, data management, analysis, display and sharing. It also allows the District control over who can enter and modify data.

The main benefit of IAPP is that it offers a public online map display. From a regional or provincial perspective, IAPP can provide a better understanding of invasive plant distribution across a landscape. For the past few years the MFLNRO has been undertaking a massive overhaul of IAPP. Ideally the new version will allow for batch upload of datasets. This would enable the District to share their inventory data on IAPP's map display if they decided this was valuable.

[38] http://www.for.gov.bc.ca/hra/plants/application.htm

5 Appendix 5. Invasive Plant Risk Assessment.

The risk assessment evaluates the relative consequence (impact) of an invasive plant species and the current predicted invasion phase in the District. This exercise builds upon the work done by C. Knox (2011). It employs an approach similar to the Ministry of Forests Invasive Plant Core Ranking Process[39] but has been simplified and catered to an urban-municipal setting. Below is the risk rating and score matrix used in the assessment. Table 16 contains the risk assessment outcome for invasive plant species currently present in the District.

Table 14. Detailed parameters of invasive plant risk rating.

Score	RISK RATING				
	Human Health & Safety	Ecosystem	Infrastructure	Recreation & Aesthetic Value	Persistence
2	Immediate and detrimental effect on human health	Impacts sensitive/rare ecosystems (e.g., creeks and riparian areas, wetlands, rocky bluffs, foreshore, etc.) in the District	Direct impact on infrastructure (e.g. roads, buildings, underground utilities)	N/A	Removal requires a trained professional
1	Potential impact on human health	Impacts forested ecosystems (e.g. plant is shade tolerant) in the District	Indirect impact on infrastructure (e.g. creates hazard trees)	Impedes recreation access and/or impacts viewscapes	Requires 3 or more repeat manual treatments
0	No direct impact	Primarily impacts disturbed sites in the District	No significant impact	No significant impact	Removal typically requires only 1 to 2 repeat manual treatments*

* Successful treatment of any invasive plant is dependent on annual monitoring/follow-up treatment to ensure the plant does not persist. Most species have seed banks which survive for multiple years.

Table 15. Score matrix for invasive plant risk rating.

RISK	
Score	Rating
4 - 6	Very High
3	High
2	Moderate
1	Low

[39] BC Invasive Plant Core Ranking Process. http://www.for.gov.bc.ca/hra/invasive-species/calculatorIndex.htm

Table 16. Invasive plant species risk assessment: plant list.[40]

Common Name	Scientific Name	RISK FACTOR						
		Human Health & Safety	Ecosystem	Infrastructure	Recreation & Aesthetic Value	Persistence	SCORE (Risk Rating)	Risk Rating
CONTROL – POST EXPANSION PHASE								
Blackberry – Himalayan Blackberry – cutleaf evergreen	*Rubus armeniacus* *Rubus laciniatus*		1		1	1	**3**	High: on restoration sites Mod: all other locations
Laurel - cherry (English laurel) Laurel - Portuguese	*Prunus lauroceracus* *Prunus lusitanica*		1			1	**2**	Moderate
English holly	*Ilex aquifolium*		1			1	**2**	Moderate
English ivy	*Hedera helix*		1	1	1		**3**	High: in trees Mod: on ground
CONTAIN – EXPANSION PHASE								
Cordgrass – salt meadow	*Spartina patens*		2			1	**3**	High
Goutweed (Bishop's weed)	*Aegopodium podgaria*		1			1	**2**	Moderate
Knotweed – Bohemian **Knotweed – Japanese** **Knotweed – Giant** **Knotweed – Himalayan**	*Fallopia x bohemica* *Fallopia japonica* *Fallopia sachalinensis* *Polygonum polystachyum*		2	2		2	**6**	Very High
Lamium (yellow archangel)	*Lamium galeobdolon*		1			2	**3**	High
Periwinkle (vinca)	*Vinca minor*		1			1	**2**	Moderate
Policeman's helmet (Himalayan balsam)	*Impatiens glandulifera*		2				**2**	Moderate
Scotch broom	*Cytisus scoparius*		2			1	**3**	High
Small flowered touch-me-not (star balsam)	*Impatiens parviflora*		1				**1**	Low
Spurge laurel (daphne laurel)	*Daphne laureola*	1	1				**2**	Moderate
ERADICATE – INTRODUCTION PHASE								
Butterfly bush	*Buddleia davidii*		2				**2**	Moderate
Clematis – old man's beard	*Clematis vitalba*		1		1		**2**	Moderate
Giant hogweed	*Heracleum mantegazzianum*	2	2			2	**6**	Very High
Hawkweed – orange	*Hieracium aurantiacum*					1	**1**	Low
Hop – common	*Humulus lupulus*		1				**1**	Low
Purple loosestrife	*Lythrum salicaria*		2			1	**2**	High[41]
Yellow flag-iris	*Iris pseudacorus*		2			1	**3**	High

[40] Species in bold are listed Noxious Weeds under the BC *Weed Control Act*

[41] Recent observations indicate that purple loosestrife may not be as invasive or as ecologically detrimental on the BC South Coast as once thought. Review the plant's risk rating if new research confirms these observations.

A **Watch List** of plants likely to be invasive in the District has been provided in the table below. The list is not exhaustive and should be updated as new information becomes available. The list includes some species that are already present (but invasion stage is unknown) as well as species that may invade in the future. Species which are listed **Noxious Weeds** under the BC *Weed Control Act* and/or are on the **proposed Prohibited Weed list** of the Provincial EDRR Program are noted. This list has been cross referenced with similar lists produced by the City of Coquitlam, District of West Vancouver and the 2011 C. Knox report. Plants are listed in alphabetical order.

Table 17. Invasive plant species Watch List.

Common Name	Scientific Name	Listed Weeds	Detection Status
Bamboo (running varieties)	Members of the *Bambuseae* tribe		Detected in the District
Bighead knapweed	*Centaurea macrocephala*	Prohibited Weed	
Bugleweed	*Ajuga reptans*		
Burr chervil	*Anthriscus caucalis*	Noxious Weed	
Brazilian elodea	*Egeria maurorum*	Prohibited Weed	Detected in Richmond
Carpet burrweed	*Soliva sessilis*		
Common comfrey	*Symphytum officinale*		Detected in the District
Common reed	*Phragmites australis*	Noxious Weed/ Prohibited Weed	Detected in Richmond
Cordgrass – dense flowered	*Spartina densiflora*	Noxious Weed/ Prohibited Weed	
Cordgrass – Common	*Spartina anglica*	Noxious Weed/ Prohibited Weed	Detected in the Fraser Delta (multiple locations)
Cordgrass – Smooth	*Spartina alterniflora*	Prohibited Weed	
Curled pondweed	*Potamogeton crispus*		
Dalmatian toadflax	*Linaria dalmatica*	Noxious Weed	
Eurasian water milfoil	*Myriophyllum spicatum*		
False brome	*Brachypodium sylvaticum*	Prohibited Weed	
Flowering rush	*Butomus umbrellatus*	Noxious Weed/ Prohibited Weed	Detected in Hatzic Lake
Garlic mustard	*Alliaria petiolata*	Noxious Weed/ Prohibited Weed	
Giant reed	*Arundo donax*	Prohibited Weed	
Gorse	*Ulex europaeus*		Detected in West Vancouver
Horse-chestnut	*Aesculus hippocastanum*		Detected in the District
Japanese butterbur	*Petasites japonicus*		Detected in the District in creeks and ravines; incorrectly identified in Knox 2011 as winter heliotrope
Kudzu	*Pueraria montana*	Prohibited Weed	
Maple – sycamore	*Acer pseudoplatanus*		Detected in the District
Mountain ash – European	*Sorbus aucuparia*		Detected in the District
Morning glory	*Calystegia sepium*		Detected in the District; concern only in early

Common Name	Scientific Name	Listed Weeds	Detection Status
			years of restoration projects
Parrotfeather	*Myriophyllum aquaticum*		Detected in Richmond
North Africa grass	*Ventenata dubia*	Prohibited Weed	
Reed canarygrass	*Phalaris arundinacea*		Detected in the District; concern in early years of restoration projects and non-forested wetlands
Yellow loosestrife	*Lysimachia vulgaris*		Detected in the District
Yellow nutsedge	*Cyperus esculentus*	Noxious Weed/ Prohibited Weed	Detected in Richmond
Wild chervil	*Anthriscus sylvestris*		Detected in Vancouver and Richmond; Noxious Weed in Fraser Valley Regional District

6 Appendix 6. Best Management Practices

Best Management Practices are provided in the following sections. Research and science in invasive plant management is constantly evolving. Updates should be made to these BMPs as new information becomes available.

6.1 Preventative Practices

The following are locally available resources detailing preventative Best Management Practices:

- Invasive Species Council of Metro Vancouver: Weeds in Mind workshops for municipal operations staff (http://www.iscmv.ca/contact)
- Invasive Species Council of BC: http://bcinvasives.ca/resources/publications/
    - Best Practice Guides for Invasive Plants in Parks and Protected Area of BC
    - Best Practices for Managing Invasive Plants on Roadsides
- BC Landscape Standards http://bclna.com/bc-landscape-standards/

6.2 Containment Strategies

In order to maximize treatment efficacy these containment strategies can be employed:

- Focus on the least disturbed area first
- Focus on small isolated patches on the outer edge of the population before large patches; these small populations occur in the zone of expansion for invasive plants
- Start upstream and work downstream to prevent source populations from spreading downstream
- Start at the outer edge of an infestation and work inward

- Focus of patches that threaten important areas nearby with no infestation or are located on possible movement corridors
- Consider source of infestation and mode of spread: if re-infestation is probable, address that issue before using resources on treatment.

6.3 Pesticide Use

Pesticides should only be used within the context of the Integrated Pest Management approach. Ultimately the benefit to be gained by use of a pesticide must outweigh all potential environmental harm and should not endanger the health of the applicant or the public.

The Nature Conservancy document, *Weed Control Methods Handbook: Tools & Techniques for use in Natural Areas*[42] should be referenced when considering the use of herbicides for treatment of invasive plants in natural areas.

As of 2014 the District's pesticide use for the control of invasive plants on District owned lands has been confined to treatment of knotweed species and giant hogweed using glyphosate. Table 18 summarizes acceptable conditions which warrant pesticide use for treatment of those species.

Table 18. Acceptable conditions for pesticide use to treat of knotweed species and giant hogweed in the District.

Target Plant	Treatment Method	Condition
Giant hogweed	Foliar spray	• When the roots cannot be effectively removed manually (growing within concrete, asphalt, or other compact substrates) • When manual removal would put staff/contractors at risk due to the size of plants or size of infestation. • When access constraints restrict manual removal (e.g. steep slopes, cliffs, etc).
Knotweed species	Stem injection	• In riparian zones (note: glyphosate cannot be used within 1m of the high water mark) • When knotweed is integrated with other vegetation (e.g. native vegetation, landscaped beds, gardens) • Public use areas (e.g. playgrounds, fields, trail edges, school grounds, recreation facilities, etc.)
	Foliar spray	• Roadsides, boulevards, medians with no human access • Large disturbed sites with no human access • Spot treatment of stems and re-growth too small to inject (<2 cm diameter) • When access does not facilitate stem injection (e.g. steep slopes, cliffs, etc).

[42] Tu, M., C. Hurd and J.M. Randall. 2001. Weed Control Methods Handbook: Tools & Techniques for use in Natural Areas. http://www.invasive.org/gist/products/handbook/methods-handbook.pdf

6.4 Species Specific BMPs

This section provides species specific Best Management Practices for invasive plant species established in the District of North Vancouver. The District is encouraged to update this information as new knowledge is acquired or Best Practices change.

Plants are in alphabetical order by common name. The moisture preference of native plants recommended for restoration sites is denoted by: D – Dry; M – Moist; W – Wet.

All information has been compiled from the sources listed below unless otherwise cited.

- BC Parks & Invasive Species Council of BC (ISCBC) "Best Practices for Invasive Plants in Parks and Protected Areas of British Columbia" 2011
- ISCBC "Grow Me Instead" Booklet 2011 Version 2
- ISCBC T.I.P.S. sheets http://www.bcinvasives.ca/resources/outreach-materials/invasive-plants-tips
- Invasive Species Council of Metro Vancouver (ISCMV) website (November 2013) (www.iscmv.ca)
- BC Ministry of Agriculture - Weeds BC website (November 2013) (www.weedsbc.ca)

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Planting Alternatives for Gardens
BLACKBERRY SPECIES **Himalayan** *Rubus armeniacus* **Evergreen/cutleaf** *Rubus laciniatus* 	Size: Evergreen, trailing shrub growing to 3m tall and 12m long Flowers: Small, white to pinkish, 5-petalled, in clusters of 5-20 Fruit: Black, shiny, hairless to 2cm in diameter, ripen from mid-summer to fall Leaves: Large, rounded or oblong, toothed leaflets Stem: Robust, stiff canes with large, flattened prickles. First year canes can root from the tips to produce daughter plants. Location: Roadsides, riparian areas, forest edges, agricultural areas, disturbed areas. Prefers full sun.	Forms dense, impenetrable thickets which displace native vegetation. Can prevent establishment of native shrub and trees species. Limits movement of large animals and reduces access for recreation. Reduces sight lines along roadways and trails. Thickets along stream banks can increase flood and erosion potential. Increases park maintenance costs such as trail clearing.	Cut or mow above-ground stems; use a Pulaski, mattock or backhoe to remove as much root as possible. Remaining root fragments will re-sprout. Mulching can reduce regrowth. Timing: Avoid treatment once fruit appears to prevent further spread. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least twice annually for re-growth and new seedlings.	Native Plants: Nookta rose *Rosa nutkana* Thimbleberry *Rubus parviflorus* Snowberry *Symphoricarpos albus* Non-Native Plants: Marionberry or Boysenberry *Rubus* 'Marion' or 'Boysen' Red raspberry (native) *Rubus idaeus* hybrids Huckleberry (native) *Vaccinium parvifolium,* *V.* m*embranaceum or* *V. ovatum*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
BUTTERFLY BUSH *Buddleja davidii*  	Size: Lanky shrub growing up to 5m tall Flowers: Lilac, purple, white or pink with a yellow to orange centre, growing in long, cone-shaped, drooping clusters; blooming in summer Leaves: Opposite, lance shaped; green above, grey and wooly below. Stem: Woody Location: Riparian areas, forest edges, roadsides, disturbed areas, gardens	Forms dense, shrubby thickets which displace native vegetation. This includes sensitive and rare ecosystems such as stream banks and rock/lichen plant communities. Increasing population in Lynn Creek riparian corridor Can supplant other plants as a nectar source, reducing the pollination of native plant species.[43]	Cut back branches and dig out entire root. Use saw to cut larger plants as close to ground as possible. If roots aren't removed, stump may sprout and require repeat cutting treatment to exhaust the plant. Herbicide application on cut stems may reduce regrowth. Bag seed and flower heads to avoid spread. Timing: November to May is best to avoid spreading seed. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Red-flowering currant (D) *Ribes sanguineum* Saskatoon berry (D) *Amelanchier alnifolia* Lewis's mock orange (D) *Philadelphus lewisii* Additional Alternatives for Gardens: Meyer lilac *Syringa meyeri* California lilac *Ceanothus* spp. and hybrids There are dozens of alternative non-invasive plants that will attract butterflies.[44]

[43] Washington Invasive Species Council http://www.invasivespecies.wa.gov/priorities/butterfly_bush.shtml
[44] Butterflies and How to Attract Them. Washington Department of Fish and Wildlife http://wdfw.wa.gov/living/butterflies/butterflies.pdf

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
CHERRY LAUREL (English laurel, common laurel). Also applicable to Portuguese laurel *Prunus laurocerasus*  	Size: Evergreen shrub to medium sized tree, growing 5-15m tall Flowers: 1cm across with five creamy-white petals; part of a narrow cluster of a 30-40 flowers; blooming in early spring to in early summer Fruit: Small cherry 1-2cm across, turning black when ripe in early autumn Leaves: Dark green, leathery, shiny, with a finely toothed serrated margin. May have almond scent when crushed. Stem: Woody Location: Forested areas, gardens; shade tolerant	Its rapid growth, evergreen habit and tolerance of drought and shade allow it to out-complete native vegetation on the forest floor. Seeds are spread by bird droppings.	Cut back branches and dig out entire root. Use saw to cut larger plants as close to ground as possible. If roots aren't removed, stump will sprout and require repeat cutting treatment to exhaust the plant. Caution: The berries, leaves and bark are all poisonous if consumed. Timing: December to June is best to avoid spreading fruit/seed. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings.	If soil disturbance occurs, plant shade tolerant native plants including: Native Plants for Restoration Sites: Red elderberry (M-W) *Sambucus racemosa* Vine maple (M) *Acer circinatum* Dull Oregon grape (D-M) *Mahonia nervosa* Additional Alternatives for Gardens: Hick's Yew *Taxus x media 'Hicksii'* Cedar species *Thuja plicata* or *occidentalis* Mexican mock orange *Choisya* species Evergreen huckleberry *Vaccinium ovatum*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
CLEMATIS – OLD MAN'S BEARD (traveller's joy) *Clematis vitalba*   (*Clematis climbing tree)*	Size: Perennial, climbing vine to 30m long. Flowers: Small, greeny-white, scented flowers Fruit/Seed: Tiny fruits have long, silky appendages. Together they form a white, fluffy ball. Leaves: Opposite, lance-shaped, pale green Stem: Woody Location: Forested areas, gardens	Can girdle trees and can cause tree failure by forming heavy mats in the canopy.	Cut stems at ground leaving vines and foliage to die. Roots are shallow and can be pulled. Timing: No restriction on timing, however dormant clematis can be easier to spot from November to March when other trees and shrubs have dropped their leaves. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Typically restoration is not needed after removal of a clematis vine) If significant tree damage has occurred, replace with a native tree species (e.g. red alder, black cottonwood, Douglas-fir, western redcedar, Sitka spruce) Alternatives for Gardens: Other clematis species *Clematis sp.* Honeysuckle *Lonicera ciliosa*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
ENGLISH HOLLY *Ilex aquifolium* 	Size: Large, evergreen shrub, growing up to 25m tall Flowers: Small, white, 4-lobed Fruit: Reddish orange berries on female plants Leaves: Evergreen, oval, shiny with 3-5 sharp spines on each side Stem: Woody Location: Forested areas, gardens; shade tolerant	Forms dense, shrubby thickets which displace native vegetation on the forest floor. Suppresses native plant germination by dominating water and nutrient consumption. Seeds are spread by bird droppings.	Cut back branches and dig out entire root. Use saw to cut larger plants as close to ground as possible. Stump may sprout and require repeat cutting treatment to exhaust the plant. Herbicide application on cut stem may reduce regrowth. Bag seed and flower heads to avoid spread. Timing: Avoid treatment once fruit appears. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings.	If soil disturbance occurs, plant shade tolerant native plants including: Native Plants for Restoration Sites: Red elderberry (M-W) *Sambucus racemosa* Vine maple (M) *Acer circinatum* Dull Oregon grape (D-M) *Mahonia nervosa* Additional Alternatives for Gardens: Holly-leaved osmanthus *Osmanthus heterophyllus* Meserve hollies *Ilex x meserve* San Jose holly *Ilex x aquipernyi* Evergreen huckleberry *Vaccinium ovatum*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
ENGLISH IVY *Hedera helix*  	Size: Evergreen, creeping vine, up to 30m long Flowers: Small, greenish-yellow, 3-5cm diameter Leaves: Waxy, 5-10cm in length; juvenile leaves 5 lobed, adult leaves unlobed Stem: Woody, often covered in root hairs Location: Forested areas, gardens; shade tolerant	Rapidly displaces native vegetation, forming dense carpets on forest floor. Can girdle trees and can cause tree failure by forming heavy mats in the canopy. Can accelerate deterioration of manmade structures.	Hand pull. Ivy climbing a tree should be a priority for removal. Cut stems around tree trunk at breast height and pull back from tree base. Caution: Do not pull ivy from high sections on trees as this may pull down large tree branches. Timing: No restriction on timing, however ivy is easiest to spot from November to March when other trees and shrubs have dropped their leaves. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: If removing an entire patch, monitor at least once annually for re-growth and new seedlings.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Salal (D) *Gaultheria shallon* Piggy-back plant (M-W) *Tolmiea menziesii* Kinnikinnick (D) *Arctostaphylos uva-ursi* Additional Alternatives for Gardens: Purple wintercreeper euonymus *Euonymus fortunei* 'Coloratus' Taiwan creeping raspberry *Rubus pentalobus* Privet honeysuckle *Lonicera pileata* Bunchberry *Cornus canadensis*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
GIANT HOGWEED *Heracleum mantegazzianum*  	Size: Very large, up to 5m tall Flowers: White flowers in umbrella-shaped heads up to 1.5m in diameter; may start blooming in June Leaves: Shiny, large with coarse, jagged edges, cut into 3 large segments Stem: Hollow, reddish-purple blotches, streaks, or spots, and stiff bristly hairs Mistaken Identity: Often confused with native cow parsnip which is smaller to 2.5m tall[45] Location: Riparian areas, roadsides, agricultural land, disturbed areas	Very dangerous to human health. Sap causes extreme skin dermatitis in the presence of sunlight. Contact can lead to welts, rashes, blistering, and scarring. If sap gets into the eyes, it can lead to temporary or permanent blindness.[46] Displaces native vegetation and reduces suitable habitat for wildlife. Produces copious seeds (100,000 seeds per plant). Dense taproot will keep producing leaves.	Due to health risk, best removed by a professional. If attempting removal yourself, cut the root crown 8-10cm below soil with a sharp blade. Pesticides may be used in certain situations where BMPs indicate that either a) the invasive plant is more harmful to the environment than the use of pesticides, or b) other control methods are not effective, feasible or are considered to be more harmful to the environment than the use of pesticides. Caution: Wear protective water proof clothing, gloves and safety goggles. Bag plant and seed heads in garbage bag to avoid spread and contact during handling/transport. Timing: April to September (before plant goes dormant). Disposal: Do not compost. Do not put in green waste container. Dispose in landfill. Cut material can be left on site to decompose if there is no risk of contact with plant for three weeks AND there are no seeds. Follow-up: Monitor every six weeks until no re-growth or new seedlings appear (seed bank lasts several years).	Plant native or non-invasive species including: Native Plants for Restoration Sites: Red elderberry (M-W) *Sambucus racemosa* Vine maple (M) *Acer circinatum* Salmonberry (M-W) *Rubus spectabilis* Additional Alternatives for Gardens: Blue elderberry *Sambucus cerulean* Ligularia *Ligularia dentate* Rodgersia *Rodgersia spp*. Shieldleaf Rodgersia *Astilboides tabularis*

[45] Giant hogweed or cow parsnip? http://www.strathcona.ca/departments/transportation-and-agriculture-services/agriculture-services/weeds/giant-hogweed-or-cow-parsnip/
[46] Work Safe BC Toxic Plant Warning for giant hogweed: http://www.worksafebc.com/publications/health_and_safety/bulletins/toxic_plants/assets/pdf/tp0602.pdf

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
GOUTWEED (Bishop's weed) *Aegopodium podgaria*  	Size: Perennial, growing to 70cm tall Flowers: White flowers in umbrella-shaped heads up to 10cm in diameter, blooming in late spring, throughout summer Leaves: Broad, toothed; solid green or variegated (white and green) Stem: Erect, hollow, grooved Location: Forested areas, riparian areas, roadsides, disturbed areas adjacent to residential gardens; shade tolerant	Displaces native vegetation, forming dense colonies in understory. Commonly dumped illegally. Grown as a garden ground cover which spreads into adjacent natural areas.	Dig plant removing as much root as possible. Take care to remove all plant parts as fragments will re-sprout. Cover treatments with black plastic (for 2 growing seasons) or cardboard and mulch are effective. Timing: Any time during growing season as spread is primarily through vegetative means not by seed. Targeting the plant in early spring and again in late spring is optimal to exhaust the plant. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least twice annually for re-growth and new seedlings.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Wild ginger (M) *Asarum caudatum* Sword fern (M-W) *Polystichum munitum* Piggy-back plant (M-W) *Tolmiea menziesii* Salmonberry (M-W) *Rubus spectabilis* Additional Alternatives for Gardens: Hostas *Hosta spp.* and hybrids Barrenwort *Epirnedium spp.* and hybrids Yerba Buena *Clinopodium douglasii* Alumroot *Heuchera* hybrids Woodland strawberry *Fragaria vesca*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
HAWKWEED - ORANGE *Hieracium aurantiacum*  	Size: Small perennial herb, up to 30cm tall Flowers: Bright orange clusters atop slender branch stems Leaves: Hairy on both sides, arranged in rosette at base of stem Stem: Single, unbranched, leafless, covered with bristly black hairs Location: Meadows, open areas, disturbed sites (roadsides, ski runs, clearings)	Displaces native vegetation, forming dense carpets. This may include sensitive and rare ecosystems such rock/lichen plant communities and alpine meadows. Reduces grazing habitat as it has no food value to wildlife. New to Metro Vancouver, found primarily along Highway 1 and ski runs in West Vancouver. Spreads by seed, roots and above ground runners. Can be spread by contaminated soil and hay.	This plant is new to Metro Vancouver. Contact the ISCMV for further information as they have prioritized treatment and have been treating the plant at Cypress Provincial Park. If growing in a garden setting, dig plant, removing as much root as possible. Take care to remove all plant parts as fragments will re-sprout. Timing: Avoid treatment once seed appears to prevent further spread. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings.	Plant native or non-invasive species including: Native and Non-Native Alternatives for Gardens: Arkwright's campion *Lychnis x awkwrightii* Pinks and campions *Dianthus spp.* and hybrids Alpine aster *Aster alpinus subsp. vierhapperi* Heart-leaved arnica *Arnica cordifolia* Blanket flower *Gaillardia aristata*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
KNOTWEED SPECIES **Japanese, Giant, Bohemian** *Fallopia species* **Himalayan knotweed** *Polygonum polystachyum*  *Components of knotweed plant*  Japanese knotweed  Himalayan knotweed	Size: Large, woody bamboo-like shrubs, 1-5m tall Flowers: Small, white/green in plume-like clusters Leaves: Variable. Japanese: spade-shaped; Giant: larger, heart-shaped; Bohemian: hybrid of Japanese and Giant; Himalayan: lance-shaped, pointy. Leaves appear in zigzag pattern along stems. Stem: reddish-brown, hollow Location: Riparian areas, roadsides, disturbed sites, landscapes. Will go almost anywhere.	Forms dense, impenetrable thickets which displace native vegetation. Dominates stream banks, increasing erosion potential. Degrades wildlife and fish habitat. Reduces access for recreation. Reduces sight lines along roadways and trails. Able to grow through cement, house foundations and walls. Spreads prolifically by root and stem segments. Fragments float downstream to form new infestations. Extensive root system capable of re-sprouting even after many years of control.	Do not treat manually. Manual treatment is ineffective and may cause further spread. Should be removed by a professional using pesticide application. Live knotweed should not be cut as this method is ineffective and disposal results in a high likelihood of spread during transport. Timing: Pesticide treatment occurs during the growing season and is most effective in late summer. Plant is dormant during the winter. Disposal: Pesticide killed material can be left on site to decompose. Cut material can be placed in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least twice annually. Continue monitoring for several years even after no re-growth appears.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Red-osier dogwood (W) *Cornus stolonifera* Willow species (W) *Salix sp.* Snowberry (D-M) *Symphoricarpos albus* Native tree species (eg. red alder, black cottonwood, Douglas-fir, western redcedar, Sitka spruce) Additional Alternatives for Gardens: Black elderberry *Sambucus racemosa var. melanocarpa* Peegee hydrangea *Hydrangea paniculata* 'Grandiflora' False Solomon's seal *Maianthemum (smilacina) racemosum subsp. Amplexicaule*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
LAMIUM - YELLOW ARCHANGEL *Lamium galeobdolon*  	Size: Evergreen, low-growing vine Flowers: Bright yellow, blooming in spring Leaves: Heart-shaped, serrated; upper sides often have silver/white pattern and wrinkly texture Stem: Square shaped, hairy Location: Riparian areas, forested areas, gardens; shade tolerant; often associated with garden waste dump sites and garden edges	Rapidly displaces native vegetation, forming dense carpets in understory. Roots can strangle other plants. Commonly dumped illegally from spent hanging baskets. Also grown as a garden ground cover which spreads into adjacent natural areas. Can produce copious seeds that are dispersed primarily by ants.	Repeated mechanical removal can be done by pulling above ground portion and digging as much root as possible. Remaining root fragments will re-sprout. Cover treatments (black plastic or thick layers of cardboard and mulch) may be effective. Pesticides may be used in certain situations where BMPs indicate that either a) the invasive plant is more harmful to the environment than the use of pesticides, or b) other control methods are not effective, feasible or are considered to be more harmful to the environment than the use of pesticides. Timing: Any time of year. Avoid large stream-side removals during rainy months where erosion is a concern. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least twice annually for re-growth and new seedlings.	Heavily mulch site after pulling. Plant native or non-invasive species including: Native Plants for Restoration Sites: Sword fern (M-W) *Polystichum munitum* Piggy-back plant (M-W) *Tolmiea menziesii* Dull Oregon grape (D-M) *Mahonia nervosa* Kinnikinnick (D) *Arctostaphylos uva-ursi* Additional Alternatives for Gardens: Hostas *Hosta spp.* and hybrids Barrenwort *Epirnedium spp.* and hybrids Yerba Buena *Clinopodium douglasii* Alumroot *Heuchera* hybrids Bunchberry *Cornus Canadensis* Wild ginger *Asarum caudatum*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
PERIWINKLE (vinca) *Vinca minor* *Vinca major*  	Size: Evergreen, low-growing herb with trailing stems Flowers: Blue to purple, blooming in spring and intermittently through summer Leaves: Shiny, dark leaves, opposite and oval shaped, 2-3cm long Stem: Slender, somewhat woody, green Location: Riparian areas, forested areas, gardens. Often originates in residential gardens. Prefers shade	Displaces native vegetation, forming dense carpets in understory. Commonly dumped illegally. Grown as a garden ground cover which spreads into adjacent natural areas.	Pull the above ground portion and dig entire root. Timing: Any time of year. Avoid large stream-side removals during rainy months where erosion is a concern. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings.	Heavily mulch site after pulling. Plant native or non-invasive species including: Native Plants for Restoration Sites: Sword fern (M-W) *Polystichum munitum* Dull Oregon grape (D-M) *Mahonia nervosa* Piggy-back plant (M-W) *Tolmiea menziesii* Kinnikinnick (D) *Arctostaphylos uva-ursi* Additional Alternatives for Gardens: Hostas *Hosta spp.* and hybrids Barrenwort *Epirnedium spp.* and hybrids Yerba Buena *Clinopodium douglasii* Alumroot *Heuchera* hybrids Woodland strawberry *Fragaria vesca* Wild ginger *Asarum caudatum*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
POLICEMAN'S HELMET (Himalayan balsam) *Impatiens glandulifera*  	Size: Annual herb, growing 1-2m tall. Emits a strong, sweet, gasoline-like smell. Flowers: Showy white, pink or reddish flowers shaped like an English policeman's helmet Leaves: Smooth, egg-shaped clustered in groups of 3-5; toothed edges Stem: Upright, hollow, smooth and purple-tinged Location: Riparian areas, roadsides, forest edges, and gardens.	Displaces native vegetation, forming dense colonies in riparian areas. Increases erosion potential when it dies back in the winter and leaves exposed soil Seed capsules explode at maturity launching seed up to 5 meters from the plant. Seed can travel by water.	Hand pull from base of plant prior to seed set. Where there is risk of steam bank erosion, cut plant at base to avoid soil disturbance. Timing: Spring. Avoid treatment once seeds appear to prevent further spread. Seeds can start as early as June. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for new seedlings (seeds last for 18 months).	Plant native or non-invasive species including: Native Plants for Restoration Sites: Salmonberry (M-W) *Rubus spectabilis* Sword fern (M-W) *Polystichum munitum* Additional Alternatives for Gardens: Cardinal flower *Lobelia cardinalis* Beard-tongue *Penstemon barbatus* Wild bleeding heart *Dicentra formosa* Red columbine *Aquilegia formosa* Pink monkey flower *Mimulus lewisii*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
PURPLE LOOSESTRIFE *Lythrum salicaria*   Photo courtesy of King County Noxious Weed Control Program	Size: Perennial herb, growing to 3m tall Flowers: Purple-magenta spikes, blooming from July to October Leaves: Opposite to whorled, dark green, lance-shaped Stem: Stiff, smooth, square, woody Mistaken Identify: Can be confused with native fireweed but purple loosestrife does not produce windborne seeds. Loosestrife more common in wetlands and moist areas. Location: Non-forested wetlands and riparian areas, disturbed wet soil areas (including roadside ditches), gardens.	Aggressively invades wetland areas displacing native vegetation. Plant roots can alter waterways. Reduces food sources for wildlife. Each plant can produce up to 2.5 million seeds. Can also reproduce by root fragments.	Pull from base of plant, taking care to remove all rhizomes. Small patches can be dug. Remaining root fragments will re-sprout. Biological control (Galerucella beetle) of large infestations is relatively successful but may require ongoing, repeat introductions and will not lead to eradication. Timing: July to August when plant is blooming (and therefore clearly visible) but prior to seeds appearing. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings. Eradication of large infestations is unlikely but repeated annual treatment will contain the plant at lower levels.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Hardhack (W) *Spiraea douglasii* Red-osier dogwood (W) *Cornus stolonifera* Willow species (W) *Salix sp.* Cattail (W) *Typha latifolia* Additional Alternatives for Gardens: Blazing star *Liatris spicata* Tall Delphinium *Delphinum elatum* Bloody iris *Iris sanguinea* Spike speedwell *Veronica spicata*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
SCOTCH BROOM *Cytisus scoparis*  	Size: Evergreen shrub, growing 3m tall Flowers: Yellow, pea-like, sometimes for red markings Fruit/Seeds: Flat pods with fine hairs on edges Leaves: Lower leaves stalked and have three leaflets. Upper leaves simple and un-stalked. Stem: Five-angled, ridged, woody, brown to green Location: Roadsides, disturbed areas, dry areas. Mainly found in non-forested sites.	Forms dense colonies which displace native vegetation. Serious threat to sensitive and rare ecosystems such as rock/lichen plant communities. Produces a toxic substance that prevents other plants from establishing. Limits movement of large animals and reduces access for recreation. Reduces sight lines along roadways and trails. Increases fire hazard.	Pull small plants when soil is moist, ensuring all root is removed. Cut large plants below ground or as close to base as possible to reduce resprouting. Resprouting more common in younger plants in fertile soils. Timing: May to July prior to seeds ripening but during flowering season when plants are stressed. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least twice annually for re-growth and new seedlings. Seed can remain viable for at least 30 years.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Nootka rose (D-M) *Rosa nutkana* Snowberry (D-M) *Symphoricarpos albus* Thimbleberry (D-M) *Rubus parviflorus* Red alder (D-M) *Alnus rubra* (will provide shade and competition for nitrogen to reduce broom growth) Additional Alternatives for Gardens: Shrubby cinquefoil *Dasiphora (Potentilla) fruticosa* Forsythia *Forsythia* hybrids Deciduous yellow azalea *Rhododendron luteum* Japanese kerria *Kerria japonica* ‘Pleniflora’

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
SMALL FLOWERED TOUCH-ME-NOT *Impatiens parviflora*  	Size: Annual herb, growing to 40cm tall Flowers: Small, whitish-yellow flowers shooting from short stems at top of plant Leaves: Broad, toothed, veined Stem: Erect Location: Moist, forested areas; shade tolerant	Displaces native vegetation, forming dense colonies in understory. Seed capsules explode at maturity. Seed can travel by water.	Hand pull from base of plant prior to seed set. Timing: Spring. Avoid treatment once seeds appear to prevent further spread. Seeds can start as early as June. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for new seedlings.	Plant native or non-invasive species including: Native Plants for Restoration Sites: Sword fern (M-W) *Polystichum munitum* Dull Oregon grape (D-M) *Mahonia nervosa* Piggy-back plant (M-W) *Tolmiea menziesii* Salmonberry (M-W) *Rubus spectabilis* Additional Alternatives for Gardens: Hostas *Hosta spp.* and hybrids Barrenwort *Epirnedium spp.* and hybrids Yerba Buena *Clinopodium douglasii* Alumroot *Heuchera* hybrids Woodland strawberry *Fragaria vesca* Wild ginger *Asarum caudatum*

Target Invasive Plant	How to Identify	Danger/Impact	How to Remove/Control	Restoration and Planting Alternatives
SPURGE LAUREL (daphne laurel) *Daphne laureola*  	Size: Evergreen shrub 0.5-1.8m tall, clusters of stems Flowers: Fragrant, yellow, bell shaped flowers clustered at branch tips Fruit: Small, black berries Leaves: Oblong, evergreen, waxy Stem: Woody, upright, often branched Mistaken identity: closely resembles members of the Rhododendron family Location: Dry forested areas, gardens; shade tolerant	Displaces native vegetation and unfavourably changes the soil chemistry. All parts of the plant are toxic. Sap can cause skin irritation and consumption of any plant parts (including berries) can be fatal. Although toxic to humans, seeds are readily eaten by birds and spread in their droppings.	Dig plant removing as much root as possible. A weed wrench may aid removal of larger plants. For very large clumps cut stems below the soil or as low as possible to prevent re-sprouting. Bag seeds and berries to avoid spread. Caution: Wear gloves and protective clothing. Do not transport in closed vehicle or burn or chip as plant can release noxious chemicals.[47] Timing: Avoid treatment once fruit appears. Disposal: Place in municipal Green Waste Program containers for composting. Do not compost in home compost bin. Follow-up: Monitor at least once annually for re-growth and new seedlings.	If soil disturbance occurs, plant shade tolerant native plants including: Native Plants for Restoration Sites: Oregon grape (D-M) *Mahonia nervosa or aquifolium* Red elderberry (M-W) *Sambucus racemosa* Vine maple (M) *Acer circinatum* Additional Alternatives for Gardens: Skimmia cultivars *Skimmia* spp. Winter daphne *Daphne odora* Rhododendron cultivars *Rhododendron spp.* Huckleberry (M) *Vaccinium ovatum* (evergreen), *V. parvifolium, or V. membranaceum*

[47] Work Safe BC Toxic Plant Warning for spurge laurel: www.worksafebc.com/publications/health_and_safety/bulletins/toxic_plants/assets/pdf/tp0601.pdf

7 Appendix 7. Restoration Resources

The following are locally available resources on developing restoration plans:

- The South Coast Conservation Program is currently developing restoration guidelines for forest, wetland, and stream and riparian restoration. Check their website for this and other guides: http://www.sccp.ca/south-coast-bc-guidelines
- Ecological Restoration Guidelines for British Columbia (Ministry of Water, Land and Air Protection) http://www.env.gov.bc.ca/fia/documents/restorationguidelines.pdf

Native plant species recommendations for restoration planting have been provided in the species specific management tables in Appendix 6. Those recommendations can be used in conjunction with the ecosystem restoration templates provided below.

7.1 Ecosystem Restoration Templates

Ecosystem restoration templates are designed to be used as guidelines when developing site-specific prescriptions. They are provided for each biogeoclimatic site series found in the District. The timeline of typical restoration treatments is summarized in **Error! Reference source not found.**. Table 3 provides ecologically suitable plant species by site series.

Table 19. Restoration treatments and timeline.

Timeline	Treatment Recommendation
Year 1	• Remove invasive plant species • Identify and mitigate tree hazards • Slope stabilization and erosion sediment control may be required on slopes greater than 15% • Option to install habitat enhancement features: coarse woody debris, standing wildlife trees, nesting and roosting sites • Install trees and shrubs
Year 2	• Monitor: if survivability of planted material is <85%, fill plant • Remove invasive plant species • Brush out competing vegetation • Water if deficit during summer months
Year 3	• Monitor: if survivability of planted material is <85%, identify limiting factor and apply alternative planting method/species • Remove invasive species • Brush out competing vegetation • Water if deficit during summer months
Year 4	• Continue monitoring until native plant community has successfully established and invasive plants do not pose a threat

Table 20. Restoration prescriptions: tree and plant species percent composition by site series.

Scientific Name	Common Name	Site Series				
		01	05	06,11	07	12
Tree Layer						
Acer macrophyllum	Bigleaf maple	30	30			
Pseudotsuga menziesii	Douglas-fir	50				
Thuja plicata	Western redcedar	20	50		20	40
Alnus rubra	Red alder		20		80	
Thuja heterophlla	Western hemlock	+	+			
Populus balsamifera spp. trichocarpa	Black cottonwood			20		60
Picea sitchensis	Sitka spruce			80		
*Abies grandis**	Grand fir*	10	10	10 (ss06)	10	
*Pinus contorta**	Shore pine*			10 (ss12)		
*Cornus nuttallii**	Western flowering dogwood*	5	5			
Shrub/Herb Layer						
Gaultheria shallon	Salal	70				
Symphoricarpos albus	Snowberry	20				
Rosa gymnocarpa	Baldhip rose	5				
Holodiscus discolor	Oceanspray	5				
Rubus spectabilis	Salmonberry		20		10	20
Oemleria cerasiformis	Indian plum		20			10
Acer circinatum	Vine maple		20			
Polystichum munitum	Sword fern		40		30	
Malus fusca	Pacific crab apple			10		
Physocarpus capitatus	Pacific ninebark			10		
Salix spp	Sitka or Pacific willow			40	30	50
Cornus stolonifera	Red osier dogwood			20		
Spirea douglasii	Hardhack			20		
Oemleria cerasiformis	Indian plum				20	
Acer circinatum	Vine maple				10	
Cornus stolonifera	Red osier dogwood					20
*Mahonia nervosa**	Dull Oregon-grape*	50	50		50	
*Sambucus racemosa**	Red elderberry*				10	
*Holidiscus discolor**	Ocean spray*	10	10		5	
*Polystichum munitum**	Sword fern*			20		

*Indicates suitable species (by current site series) to begin incorporating given the expected climate change over the next 20 years.